

SELECT OPINIONS ON VOL. I.

I consider that the work is a most interesting and valuable contribution to chemical History ; and exhibits an amount of learning and research which does the author the greatest credit.—*Sir Henry E. Roscoe.*

A new and interesting chapter has been added to the history of sciences and of human progress.—*M. Berthelot.*

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That unusually interesting work.—*Pharmaceutical Post.* (Vienna)

We doubt if one more eminently qualified than Professor Ray could be found for the difficult task of sifting such evidences, and eliciting from them an intelligible and orderly account of the development of Indian Chemistry.—*The Times of India.*

This Pioneer work is a monumental labour of love.—*The Englishman.*

HISTORY OF HINDU CHEMISTRY

**A
HISTORY OF HINDU CHEMISTRY**

**FROM
THE EARLIEST TIMES TO THE MIDDLE OF THE
SIXTEENTH CENTURY A. D.**

**WITH
SANSKRIT TEXTS, VARIANTS, TRANSLATION
AND ILLUSTRATIONS**

**BY
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VOL. II

CALCUTTA

**THE BENGAL CHEMICAL & PHARMACEUTICAL
WORKS, LIMITED**

London : WILLIAMS AND NORGATE

1909

CALCUTTA

PRINTED AND PUBLISHED BY N. N. PALIT
AT THE BENGAL CHEMICAL STEAM PRINTING WORKS

82, Maniktala Main Road.

To the Memory of
M. P. E. BERTHELOT

I dedicate this volume of the History
of Hindu Chemistry.

PREFACE

The second and concluding volume of the *History of Hindu Chemistry* is now presented to the public.

When the first volume was under preparation, it was feared that many valuable works on Hindu Chemistry referred to in *Rasārṇava*, *Rasaratna-samuchchaya*, *etc.*, had been lost for ever. Pandit Navakānta Kavibhūṣana was deputed to Benares to make a searching enquiry and his labours have been rewarded by the discovery of several late MSS., including one of *Rasahrīdaya*. This last-named work is of surpassing interest considering its comprehensiveness and antiquity. Two more transcripts of it have also been procured from the Libraries of the India Office, London, and of the Darbār, Nepal. A copy of *Rasendra-chūdāmāni* obtained from the Library of the Deccan College, Poona, has also been of signal help. A critical study of the new materials throws a flood of light on the dark recesses of the history of Indian Chemistry. As a halo of literary and scientific activity including the pursuit of alchemy circles round the prominent figure of Nāgārjuna, considerable space has been devoted to a discussion of his age in the Historical Introduction.

It was with diffidence and hesitation that I placed the remotest limit of alchemical *Tantras* in the 12th century A. D. It now transpires that this date is to be pushed back by several centuries.

A *History of Hindu Chemistry* would be rightly regarded as incomplete which did not deal with the constitution of matter and the various hypotheses in regard to it. The European historian of chemistry has always turned his eyes to Greece as the perennial fountain of knowledge on this as on other subjects. And it is but natural that he should do so. * The Hindu atomistic school has not hitherto, I am afraid, found an interpreter who could do full justice to it. Colebrooke's presentation of it with which I had to content myself in the first volume is masterly so far as it goes, but is fragmentary. Not feeling myself equal to the task I applied for help to Mr. Brajendra Náth Seal, Principal, Victoria College, Kuch Behar. Principal Seal has kindly responded to my appeal with alacrity. It is to be hoped that a long-felt *desideratum* has at last been supplied.

The frequent references which have been made to the first volume must be taken to mean the second edition of it. Those who happen to possess copies of the first edition will not, however, be put to any serious inconvenience.

* *Ibid.* Vol. 1, Intro. xliii.

PREFACE

I avail myself of this opportunity to express my cordial thanks to Pandit Harischandra Kavi-ratna, late Professor of Sanskrit, Presidency College, and my collaborator in the editing of the text of *Rasārṇava* in the *Bibliotheca Indica* series.

In the preface to the first volume I presumed to narrate the circumstances under which I undertook the composition of my History. The great chemist and savant, whose inspiration has been my guiding principle throughout the arduous task and whose lengthy and appreciative review of the first instalment has been a stimulus in the continuation of it, is no more. Marcellin Berthelot breathed his last on March 18, 1907, leaving the world of science poor indeed. It was with the view of coming into personal contact with the illustrious scientist that the author made a pilgrimage to Paris in March, 1905. The long interview which he had with M. Berthelot and the reception which was accorded to him at a meeting of the Academy of Sciences by its late Perpetual Secretary, as also by its President, M. Troost, made a deep and lasting impression on his mind.

Alas, for the vanity of human wishes ! These pages will no longer be greeted by the eager and indulgent eyes of M. Berthelot. All that now remains for me is to dedicate this volume to his sacred memory.

It is with mingled feelings that I mark the hour of my final deliverance from a self-imposed task which has occupied all my spare time during the last 15 years and more—feelings not unlike those which overpowered the Historian of the Roman Empire. The reader will, I hope, forgive me if I venture to give expression to them in the words of Edmund Gibbon himself. “I will not dissemble the first emotions of joy on the recovery of my freedom. * * * But my pride was soon humbled, and a sober melancholy was spread over my mind, by the idea that I had taken an everlasting leave of an old and agreeable companion.”

The Hindu nation with its glorious past and vast latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive for regaining their old position in the intellectual hierarchy of nations, I shall not have laboured in vain.

PRESIDENCY COLLEGE. }
June 1, 1909 }

P. C. RAY.

PRELIMINARY REMARKS ON THE
MECHANICAL, PHYSICAL AND
CHEMICAL THEORIES OF
THE ANCIENT HINDUS.

My paper on the *Mechanical, Physical and Chemical Theories of the Ancient Hindus* is intended to be a synoptic view of the entire field of Hindu Physico-chemical Science, so far as this reached the stage of positive Science as distinguished from the prior mythological and empirical stages. As the work in which my paper appears relates to Hindu Chemistry, I have elaborated the chemical portions, including the Hindu account of the constitution of the fats and oils, and the organic tissues, in addition to Hindu inorganic chemistry. I have also briefly noticed the chief chemical industries of the Hindus which secured them an easy pre-eminence in manufactures for a thousand years, and, in the *Addenda*, given some interesting recipes relating to several matters of chemical technology. Of mechanico-physical theories, I have expounded the Hindu conception of Energy, potential as well as kinetic, and of molecular motion, so far as they are applied to the elucidation of problems of a physico-chemical nature, *viz.*, the constitution of

matter, the genesis of atoms and their infra-atomic constituents, and the chain of mechanical causation in the system of Nature. I have also touched on the Hindu theories of light, heat and sound, as implying current or wave motion, leaving the elaborate exposition to my paper on Hindu Mechanics and Physics. In the *Appendix*, I have added a brief account of the Scientific Method of the Hindus, which shows that all this was not a mass of unverified and unverifiable speculation (the very antipodes of science), the charge usually brought against Hindu thought and culture,—but professed to be the outcome of a Scientific Methodology which, in its formulation of the canons of the two fundamental Inductive Methods, is more comprehensive as well as more original and suggestive than Mill, and which, as regards its Applied Logic of the Sciences, (*e. g.* the Logic of Therapeutics, of Grammar *etc.*), is a standing testimony to the systematic completeness and rigour of the Hindu scientific mind. The difficulties of my task have been formidable, but I have not written one line which is not supported by the clearest and most authoritative texts. The ground trodden is, for the most part, absolutely new. I have gone back to the *origines*, and studied the authorities at first hand, being resolved to eschew all second-hand sources of information. Fortunately, the Sanskrit philosophico-scientific terminology,

however difficult from its technical character, is exceedingly precise, consistent and expressive. The materials also are full, and the sources of information corroborate one another. Another difficulty I have sought to guard myself against is the unscientific, unhistorical but very common and almost inevitable habit of reading modern ideas into old guesses or speculations of a happy-go-lucky or nebulous character. I do not think that the mere passion for Truth is a sufficient safeguard against this fatal facility of unconscious distortion or misrepresentation. A true historical perspective can only be acquired by historico-comparative studies, with the application of the correct historico-comparative method (*vide* the Introduction to my Comparative Studies in Vaishnavism and Christianity). I have also practised, or tried to practise, a habitual understatement, without consciously falling into that '*suppressio veri*' which is so often a '*suggestio falsi*.' How far I have succeeded in exhibiting the truth about Hindu science or the Hindu scientific mind is a question which I leave to competent judges to answer.

Before concluding, I must advert to my use of the terms "isomeric" and "polymeric" in senses different from the current ones, though suggested by the principle of analogous extension. Instead of coining new terms, I adopted (perhaps with a questionable freedom) these existing ones to ex-

press the Hindu idea of distinctions of chemical substances due merely to difference in spatial position or arrangement among the particles, without any implications whatever as to percentage composition or molecular weight. A study of the original sources has made it clear to me that a "Bhúta" in Hindu Chemistry represents a class of elements composed of similar atoms, and the different elementary substances comprised under one and the same "Bhúta" are 'isomers', in this limited sense, in reference to the atoms, being specifically constituted by differences of spatial position and arrangement among the latter. This is true of the Sāṅkhya-Pātañjala and the Nyāya-Vaiśeṣika alike. But, in the Sāṅkhya-Pātañjala, the atoms themselves are composed of Tanmātras; and in one view, the atoms that enter into the "isomeric" modes of the same "Bhúta" are themselves "stereo-isomers" in reference to the Tanmātras. A tri-Tanmātric atom, for example, may have different isomeric forms which would account for the divers modes of the "Bhúta" originating with this class of atoms. Hence under the Sāṅkhya Pātañjala, I speak of "isomeric" atoms, while under the Nyāya-Vaiśeṣika I confine myself to the phrase "isomeric modes of the same Bhúta". It appears to me also that in the Sāṅkhya-Pātañjala view, while an atom of a particular kind (say a tri-Tanmātric or a tetra-Tanmātric one) may have "isomeric" forms of its own, the

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Introduction

CHAPTER I

On the age of Nagarjuna and the Buddhist Alchemical Tantras.

IN the first Volume it has been incidentally mentioned that side by side with the Sivaite Tantras we have their Buddhist counterparts in which the salient features of the former appear.* The question now arises : when did the votaries of the religion of Śākyamuni find themselves called upon to engraft upon their simple and pure creed the *ensemble* of the gross and grotesque superstitions, the hideous incantations, as also the speculative, the metaphysical and esoteric phases of spiritual aspirations of which the Tantras are the repositories? The answer cannot be given off hand

Rise, development
and propagation of
Mahāyānism.

in a few words, for it will lead us to a discussion of the origin and development of Maháyánism. Under ordinary circumstances we should have considered it beside our purpose to devote much space to this subject in a work dealing with the history of chemistry. But it so happens that the most prominent figure in Indian alchemy, who is acknowledged on all hands to be the discoverer of the processes of distillation, sublimation etc., is no other than the reputed founder of the Mádhyamika system of philosophy, the renowned Nágárjuna. A brief and rapid survey of the causes which led to the origin of Maháyánism and its intimate connection with the tenets of the Sivaite cult will be of help to us.

It is one of the saddest episodes in the history of the great religions of the world that the purity of life, right conduct, right living—in short, the moral code upon which their founders have always laid particular stress, soon begin to occupy a subordinate position and a dogmatic theology springs up in time, which gives occupation to the subtlest intellect.

As for the masses of the people it is doubtful if ever they have remained contented with the mere ethical aspect of a religion. At any rate we find that immediately after the tidings of the death of Buddha had spread about there was a squabble among his followers for the possession of the master's corporeal relics and in course of time stūpas were raised over them, which no less than the three jewels (*Ratnatraya*)—the Buddha, the Dharma and the *Samgha*,—and the Bodhi-tree became objects of worship of the devotee. The Chaityas, Vihāras and other sanctuaries of divers sorts, with which Buddhistic India was dotted over in the first and second centuries after the decease of the great Teacher, afforded asylums for a vast multitude of monks, who, freed from all worldly cares, found ample leisure to formulate and draw up a code of spiritual and disciplinary exercises.

Although their high ideal was “to lead sweet lives of purest chastity” and induce their lay brethren to follow in their footsteps, rituals and ceremonials of an imposing and

elaborate character soon obscured the ray of light which shone forth from the founder. Thus we find that within 150 years after the passing away of Buddha tedious and circumstantial regulations as to the quality of robes to be worn by the Bhikshus, the mode of bathing and fasting, the taking of the midday meal, the drinking of unchurned milk, probation and penance, dwellings and furniture and so forth were amongst the weighty subjects for discussion in the Second General Council.* We need not pursue the subject further. The reader who is interested in the study of comparative religions will find striking parallels in the early history of the Christian Church. †

* "On the daily Life of the Bhikshus." *Vinaya Texts* (S. B. E. Series). The Chullavagga, Pt. iii, p. 66.

† The Sermon on the Mount was more or less forgotten. Idolatry disappeared. it is true, but only to re-appear in the shape of Mariolatry and the worship of Saints and relics. In the heat of the schismatic strifes, Christian Charity had to make shift for itself as best as it could. Theologians were busy with the interpretation of the writings of the fathers. In a word, the dogmatic to a large extent superseded the moral element of religion.

We are not concerned here with tracing the rise, progress or decline of Buddhism ; if we have at all referred to its excrescences, it is only to prepare the mind of the reader for the proper understanding of the Maháyánist development.

The India of Asoka and of the fourth and third centuries B. C. was in the main Buddhist, but it should not for a moment be supposed that the old faith was extinct. The triumph and ascendancy of the teachings of Śákyamuni and his followers were due in a large measure to the fact that they drew upon, and incorporated into, their creed much that was essentially of Hindu origin.* As Dr. Bhándárkar observes :—

* Prof. Rhys Davids expresses the same views in several places :—"There is ample evidence even in the books of the orthodox body of Brahman teachers to show that when Buddhism arose there was not only much discussion of the ultimate problems of life, and a keen interest in the result, but also that there was a quite unusually open field for all sorts of speculations."—"Buddhism," American Lectures on the History of Religions (1896), p. 26. Again : "But Buddhism is essentially an Indian system. The Buddha himself was,

"But it was not the metaphysical doctrines of Buddhism that influenced the masses of the people. What proved attractive was its ethical side. The Buddhist preachers discoursed on Dharma or righteousness to the people. Such discourses on Dharma without the introduction of any theistic idea have their representatives in the Brahmanic literature. In many of the episodes of the Mahábhárata especially in the Śánti and Anusásanika books we have

throughout his career, a characteristic Indian. he was the greatest and wisest and best of Hindus."—*ibid*, p. 117. The same high authority puts it more tersely when he says: "This is partly, no doubt, because we call them Buddhists, and imagine them, therefore, to belong to a separate class, quite distinct from other Indians of that stock. The Buddhists were, as a matter of fact, characteristically and distinctly Indian."—"Buddhist India," p. 165. Cf. "Buddhism, in fact, may be regarded as a reformed phase of Hindu religion and ethical activity. The Buddhistic doctrine of the vanity of the world had been thoroughly disseminated by Yājñavalkya (in the Śatapatha Bráhmaṇa) and with it the practice of subsistence upon alms as Pravrajika or Bhikshu; and a fruitful soil had thereby been prepared for Buddhism." Weber's "Hist. Sans. Lit." trans. 3rd Ed. (1892) p. 285. Again "This teaching contains, in itself, absolutely nothing new; on the contrary, it is essentially identical with the corresponding Brahminical doctrine; only the fashion in which Buddha proclaimed and disseminated it was something altogether novel and unwonted."—*ibid*, p. 289.

simply ethical discourses without any reference to God, of the nature of those we find in the Buddhistic works; and sometimes the verses in the Mahá-bhárata are the same as those occurring in the latter. There appears to be at one time a period in which the thoughts of the Hindus were directed to the delineation of the right conduct in itself without any theistic learning. And Buddhism on its ethical scale represents that phase. Right conduct is the last of the four noble truths of Buddhism."

* * * * *

- ✓ "It was this phase of Buddhism that with the strenuous efforts of the missionaries and of the Emperor Asoka enables it to achieve success amongst the masses of the people; and what was wanting on the theistic side was supplied by the perfection and marvellous powers attributed to the founder of the religion. Without this faith in the perfection or, what we should call the divine nature of Buddha, a mere ethical religion would probably not have succeeded. Buddhism was not a social revolution as has been thought by some writers. It was a religion established and propagated by persons who had renounced the world and professed not to care for it. From times of old there existed in the Indian community such persons who were

called *Sramanas* and belonged originally to all castes. These gave themselves to contemplation and sometimes propounded doctrines of salvation not in harmony with the prevalent creed. Buddhism was not even a revolt against caste, for though men from all castes were admitted to the monastic order, and though in the discourses of Buddha himself and others the distinction of caste is pronounced to be entirely worthless, still the object of those who elaborated the system was not to level caste distinctions. They even left the domestic ceremonies of their followers to be performed according to the Vedic ritual. This is one of the arguments brought against Buddhism by Udayanáchárya. "There does not exist," he says, "a sect, the followers of which do not perform the Vedic rites beginning with *Garbhádhána* and ending with the funeral, even though they regard them as having relative or tentative truth."* Buddhism, however, was a revolt against the sacrificial system and denied the authority of the Vedas as calculated to point out the path to salvation. And

* *नान्यत्र तद्दर्शनं यत्र संवत्समतदित्युक्तापि गर्भाधानाद्यन्येष्टिपर्यन्तां वैदिकीं क्रियां जनो नानुतिष्ठति । Atmatattvaviveka, Calc. Ed. of Samvat 1906, p. 19. संवत्स relating to संवत्ति, a Buddhist technical term.*

this is the root of the hostility between itself and Brahmanism.”*

The zealous missionaries of Buddhism captured the heart of the masses by appealing to their moral instincts. Persuasion and not persecution was the instrument they chose to wield. King Asoka proclaimed universal toleration ; he inculcated respect for Brahmins as well as Sramanas or ascetics of all sects. It is a relief to find that the mighty monarch had never recourse to brute force for the propagation of his creed. We are spared all the scenes of blood, rapine and violence, which disfigure the pages of religious history in the West.

It has already been pointed out that Buddhism itself may be looked upon as an off-spring of Hinduism ; nay, it is a logical outcome of the principles enunciated in the

*“ A peep into the Early History of India from the foundation of the Maurya Dynasty to the fall of the Imperial Gupta Dynasty ” (B.C. 322—Circa 500 A. D.) pp. 362-363.

Journal of the Bombay branch of the Royal Asiatic Society (1900), Vol. xx. No. I.VI.

Sāṃkhya system of philosophy. If India so readily responded to the teachings of the new faith, it is not because she renounced Hinduism but because she found that all that was highest and noblest in the latter was absorbed in the former. The great Teacher who now arose gave only a new shape and direction and a vigorous impetus to the germ of ideas already in existence and turned them to capital account. A good deal of confusion may be avoided by bearing in mind this aspect of the question. When speaking of Buddhist India one is apt to rush to the conclusion that every vestige of Hinduism had disappeared off the face of the vast continent. As a matter of fact even during the zenith of Buddhistic glory Brahminism was rearing its head and was professed by not a few among the cultured and intellectual classes and was ready to assert itself whenever a favourable occasion arose.

In the second century B. C., we find the Kābul valley, the Punjab and Mūlava ac-

knowledging the sway of the Princes of the Turkish race.* Wema Kadiphses, the second of the Kushana Dynasty is spoken of as a devotee of Mahesvara ; his coins bear the emblem of Nandin on the reverse, which is accompanied by a human figure which holds a trident in its right arm representing Siva.† The last three Kushanas—Kanishka, Huvishka and Vāsudeva—have been noticed in the *Rājatarāṅginī*,‡ and the emblems on the reverse of their coins are figures of deities borrowed from the Greek, Persian and Brahminical pantheon and of Buddha. Thus the Gods of all these four religions shared the adoration of these Turkish Kings. But the figure of Buddha in the

* Lassen "Indische Alterthumskunde," Vol. ii, pp. 811 13 Ed. 1874.

† *Ibid*, pp 808-811.

‡ See next page. Regarding the reliability of the account in the *Rājatarāṅginī*, Dr. Stein observes :—"Kalhana's account of the reign of these kings, who are supposed to have ruled simultaneously, is brief enough, but undoubtedly preserves data of genuine historical tradition. It clearly describes them as princes of Turuska, *i. e.*, Turkish nationality, as powerful sovereigns and as faithful patrons of the Buddhist Church. On these points the statements of

sitting or meditative and the standing posture is to be found on the coins of Kanishka alone.*

In the Buddhist ecclesiastical history Kanishka occupies a prominent place. It was in his reign and under his patronage that the Third Council was held to settle the canon once again. The church was convulsed by internal dissensions and schisms, resulting in its being split up into as many as 18 sects. "The most significant trait of the Third Council is that it closed a period of old quarrels between the sects ; it did not prevent the rise of new aspirations. Maháyánism, which in an incipient stage was already existing erelong, boldly raised its head."†

the Chronicle are fully supported by the evidence of our most authentic records. The continued existence of the three places, Kanishkapura, Hushkapura, and Jushkapura, which are described as foundations of these kings and which still survive to the present day is likely to have assisted in preserving a recollection of their founders."

* Percy Gardner : " Coins of Greek and Scythic kings " pp. 129 ff.

Cunningham : " Num. Chr.," 1892, pp. 63 ff.

† Kern : Manual of Ind. Bud. (Grundriss d. Indo.-Arischen Phil.) p. 122.

Hinduism was now very much alive. After the Third Council the distinction between the Hínayánists and the Maháyánists became more and more accentuated. The apostles of the latter development became convinced that in order to draw into their folds the bulk of the people some sort of compromise was necessary, that orthodox Buddhism in all its rigidity must be given up. In other words, the neo-Buddhism which now sprang into existence began to absorb and assimilate the popular form of Brahminism and thus swell the ranks of its followers. A purely ethical creed has never secured a following except perhaps among a chosen few. To quote the eloquent words of the historian of "Rationalism in Europe":—

"There arise from time to time men who bear to the moral condition of their age much the same relations as men of genius bear to its intellectual condition. They anticipate the moral standard of a later age, cast abroad conceptions of disinterested virtue, of philanthropy, or of self-denial that seem to bear no relation to the spirit of their time, inculcate duties and suggest motives of action that

appear to most men altogether chimerical. Yet the magnetism of their perfection tells powerfully upon their contemporaries. An enthusiasm is kindled, a group of adherents is formed, and many are emancipated from the moral condition of their age. Yet the full effects of such a movement are but transient. The first enthusiasm dies away, surrounding circumstances resume their ascendancy, the pure faith is materialised, encrusted with conceptions that are alien to its nature, dislocated, and distorted till its first features have almost disappeared. The moral teaching being unsuited to the time becomes inoperative until its appropriate civilisation has dawned, or at most it faintly and imperfectly filters through an accumulation of dogmas, and thus accelerates in some measure the arrival of the condition it requires." Vol. i, p. 305, Ed. 1900

The same historian in explaining the rapid spread of Christianity in Europe observes in another place :—" It triumphed not so much by superseding rival faiths as by absorbing and transforming them. Old systems, old rites, old images were grafted into the new belief, retaining much of their ancient character, but assuming new names and a new complexion."

Among the bold spirits who took a leading part in this renovation the name of Nágárjuna stands conspicuous. The Mádhyamika system, with its axiom—*sarvam Sunyam*—a form of Pyrrhonism pushed to its extreme limits,

Nágárjuna : a leading representative of Maháyánism.

which is an essential part of Maháyánism is generally ascribed to him. Northern Buddhist literature is replete with the marvels and miracles performed by him, and tradition has invested him with superhuman powers. Hiouen 'Thsang calls him along with Deva, Asva-ghosha and Kumáralabdha, "as the four suns which illumine the world."* As early as A.D. 401-409 we find a life of Nágárjuna Bodhi-sattva translated into Chinese.† Tíranátha has committed to writing all the floating mass of legends connected with this venerable name, but as the Tibetan monk wrote so late as the beginning of the 17th century A.D., and as nothing was too astounding for his pious credulity, we have here only nuclei of facts round

* Julien's texts, Vol. ii, p. 214.

† Bun. Nanjio's Catalogue, Ap. i, No. 3.

which have gathered accretions of vast proportions. It is now almost a hopeless task to separate the grain from the chaff. Nevertheless we can glean certain historical data from all that have been handed down. Before proceeding further we think it proper to treat the reader to a specimen of the materials with which one has to deal. We cull the following bits from the "Life and Legends of Nágárjuna" gathered chiefly from Tibetan records including Táránátha's "History of Buddhism."

"A rich Brahmin of the Vidarbha country to whom no son had been born for many years, once saw in a vision, that if he gave alms to, and entertained one hundred Brahmins, he could get a son. Accordingly he made offerings and prayers to the God and entertained one hundred Brahmins. After ten months his wife gave birth to a son. The rich man invited learned astrologers to predict the fortunes of his child ; but they found that it could not live more than a week. In all other respects the child was calculated to be fortunate..... The astrologers assured them (his parents) that if they entertained one hundred Bhikshus, it would

live seven years, beyond which its life could not be prolonged by any means whatever. When the seventh year was about to expire the parents were overwhelmed with grief. To avoid the painful sight of their son's predicted death, they caused him to be removed to a certain solitary place in company with a few retainers.

“As the boy (Nāgārjuna) was passing his mournful days, one day the Mahābodhisattva Avalokiteśvara Khasarpana visited him in disguise and advised him to go to the great monastery of Nāleन्द्रa in Magadha as the surest means of escaping from the hands of death. He accordingly repaired to that famous Vihāra and arriving at the gate recited some gāthās. During that time the great sage Srī Saraha Bhadra was the high priest of Nāleन्द्रa, who ordained Nāgārjuna a Bhikshu of the Vihāra. * * * * During the latter part of his office the country was visited by a famine in consequence of which the monks fell into great distress. The Manager became very thoughtful about the terrible effects of the natural calamity. Distress and scarcity compelled the congregation more keenly to feel the necessity of money. The monks now determined to devise some means of acquiring treasures for the support

of the famished congregation, and Nāgārjuna accordingly started on an expedition to visit an island in the great ocean where lived a great saint well versed in the art of alchemy. As the sea could not be crossed by any earthly means, he, by dint of his divine learning, got two leaves of an enchanted tree, by means of which he crossed the ocean and miraculously visited the island and presented himself before the sage who was greatly surprised to see a human being arrived at his abode deemed inaccessible to mortal beings. The sage earnestly inquired how he succeeded in achieving this wonder. Nāgārjuna replied respectfully stating to him the reasons of his visit and circumstances that brought him thither. He also showed him one of the enchanted leaves, concealing the other in his mendicant's platter. He begged him to teach him the art of turning metals into gold. The sage consented to the proposal, but not liking to let the wonderful art be known in Jambudvīpa, he determined to detain him for ever in the island by depriving him of the enchanted leaf. To effect this, he said that he could not teach the art of alchemy unless Nāgārjuna consented to part with the leaf. Nāgārjuna consented, and was taught the art. When it was fully mastered,

he flew towards the Indian Continent by the help of the remaining leaf. Returning to Nāḷendra, by means of his easily acquired wealth he supported the whole body of monks. By his religious practices he obtained Siddhi (perfection). He refuted the theories of *Samkarāchārya* * and imparted religious instruction to the monks of Nāḷendra.

“Nāgārjuna returned to his country after a visit to Uttarakuru and erected many chaityas and temples, composed many works on science, medicine, astronomy and alchemy. After the death of Saraha Bhadra, the office of high priest fell upon Nāgārjuna, which he managed with great ability and indefatigable zeal. He matured the Mādhyamika philosophy which was only conceived by his illustrious teacher Saraha.”

“Nāgārjuna is said to have been a great friend of king De-Chye (*Samkara*) of S. India, whom he converted to Buddhism.”†

* An instance of glaring anachronism. *Samkara* flourished in the 8th—9th century A. D. See below, foot-note to p. xxii.

† S. C. Dās: Journ., As. Soc. li, Pt. i, pp. 115—120.

One thing seems to be clear from the above, namely, that Nágárjuna was born and brought up in the Brahminical faith but was afterwards converted to Buddhism and was celebrated as an alchemist.

Táranátha, it is true, completed his History in 1608 A. D., * but he derived his materials from Tibetan sources and the analysis of Dulva by Csoma goes to confirm this account. We have already made use of the record left us by Hiouen 'Thsang. † It is thus clear that all the testimonies concur in ascertaining Nágárjuna not only as the originator of the Mádhyamika philosophy but also as an

Nágárjuna as an
adept in magic
and alchemy.

adept in magic, conjuration
and alchemy, and that even
so early as the 7th century

A. D. The exact time during which he flourished is a matter of controversy. He is generally regarded as a contemporary of

* Schiefner : Gesch. d. Bud. Pref. vi.

† *Vide* Vol. i, Intro. xciii.

Kanishka. One cannot go far wrong in assigning *circa* 150 A. D. as the date of his succeeding to the Patriarchate.*

* According to Lassen Nágárjuna lived about A. D. 23 during the reign of Kanishka. The *Rájataramgini* says: "Then there were in this land three kings called Hushka, Jushka and Kanishka, who built three towns named after them (Hushkapura, Jushkapura and Kanishkapura)..... During the powerful reign of these [kings] the land of Kásmír was, to a great extent, in the possession of the Buddhas. At that time 150 years had passed in this terrestrial world since the blessed Sákya Simha (Buddha) had obtained complete beatitude (Nirvána)..... And a Bodhisattva lived (then) in this country as the lord of the land, namely, the glorious Nágárjuna..... Stein's trans. Vol. I, pp. 30—31. As the tradition of the Northern Buddhists as recorded by Hiouen T'sang (*Si-yu-ki*, i. pp. 99, 151), the Tibetan Dulva (Csoma, *As. Res.* XX, pp. 92, 297) as also Schiefner (*Tár. Gesch. d. Bud.* p. 301) concur in placing the commencement of Kanishka's rule 400 years after Buddha's Nirvána, the date assigned here to Nágárjuna is rather curious. Lassen sums up his conclusion on this knotty point in these words:—"Wegen der grossen Anzahl seiner Münzen mus dem *Kanishka* eine ziemlich lange Regierung zugeschrieben werden; ich glaube daher annehmen zu dürfen, das er etwa bis 40 nach Chr. G. regiert habe." Fleet maintains B. C. 57. V. Smith *c.* 120 A. D. While Messrs. Bhándárkar *c.* 278 A. D. (*Journ. Bombay Br. Roy. As. Soc.* Vol. XX, No. lvi, pp. 269—396) as the date of Kanishka..

An important document has been preserved for us in its Tibetan and Chinese versions, which seems to have an historical basis. It is in the shape of a "Friendly Epistle of Nágúrjuna to king Udyana." *

Nágúrjuna as a contemporary and friend of king Sadváhana.

The original in Sanskrit, entitled *Suhrillekha*, has not yet been recovered and probably

been lost. Udyana in the Tibetan subscription is Bdyé-Spyod=Sadváhana.† This Sadváhana is a prominent figure in the history of S. India. In ancient Sanskrit literature he is frequently spoken of as a patron of learning and there are several literary reminiscences associated with this name. ‡

* *Vide* Wenzel : Journ. Pali Text Soc. (1886), p. 1.

† S. C. Dás (l. c.) says : " Nágúrjuna is said to have been a great friend of king De-Chye (*i. e.* Samkara) of S. India, whom he converted to Buddhism." Now De-Chye=Bdyé-byed according to modern pronounciation. Dás is evidently in error in rendering De-Chye as Samkara (Wenzel).

‡ *Cf.*—Kámasútra of Vátsyáyana. कर्तव्या कुललः शातकणिः शातवाहनी महादेवीं मलयवतीं [अचान] । Referring to a " new " MS. of *Harshacharita* in his possession Hall remarks—" for Sáliváhana I there find Sátaváhana"—Intro. to "Vásavadattá," p. 54, This by implication would suggest that the other MS. had the reading Sáliváhana.

Now "the Andhrabhrityas or Sātavāhanas ruled over the Deccan from B. C. 73 to about A. D. 218, *i.e.* for about 3 centuries.

"The period during which they ruled over Mahārāṣṭra must have been a prosperous one in the history of the country. Hence several traditions with regard to different kings have been preserved. But that Sālivāhana or Sātavāhana was a family name must have been* forgotten and different princes of the dynasty have been confounded and identified. Thus Hemachandra in his *Desikosha* gives Sālivāhana, Sālana, Hāla and Kuntala as the names of one individual." *

The So-to-p'o-ho of the Chinese version of the "Friendly Epistle" has been identified with one of the Sātavāhanas or Andhra kings, possibly Yajna-Srī-Sātakarni, who seems to have reigned about 172—202 A. D. There is, therefore, nothing improbable in this particular, Sātavāhana being a contemporary of Nāgārjuna. In the alchemical Tantra, "Rasaratnākara," ascribed to Nāgārjuna,

* Bhāndārkar's "Early History of the Deccan"—p. 36.

there is a dialogue between this sage and Śālivāhana (p. 6). We shall revert to this subject later on.

Numerous works have been fathered on Nāgārjuna and it is an open question if any of them be genuine.* As is well known Vyāsa or more properly named Vedavyāsa has been taken to be the compiler of not only the four Vedas but also of all the Purāṇas put together. Piety and credulity go hand in hand and are seldom troubled with questions of anachronism. Plato, Democritus and Geber have been held responsible for writings which ap-

Nāgārjuna as a comprehensive name of the activity of Mahāyānaism.

peared several centuries later. Names, venerable and illustrious, have often been pressed into service to lend weight and dignity to productions which otherwise would not have commanded respectful hearing. On the whole we are inclined to agree

* In Bunyin Nanjio's Catalogue of the Bud. Tripitaka there is a list of 24 works ascribed to Nāgārjuna. The *Suhṛillekha* was translated into Chinese in 434 A. D. App. pt. I, p. 368.

with Kern when he says, "The ~~figure of~~ ^{RISHNAI} Nágúrjuna, so prominent in the history of the rise of Maháyánism, shows a double character. It is, on the one side, the name of an influential person, the first eminent leader of a school imbued with Hinduism and the methods of Indian scholastic philosophy. On the other hand, Nágúrjuna is simply a comprehensive name of the activity of Maháyánism in the first phase of its onward course."*

* In Vol. I of this work (Intro. xciii), we quoted Albérúní as to the date of Nágúrjuna. This cultured Arab, ordinarily a very trustworthy guide, derived his information from the Brahmins of that part of India from which every vestige of Buddhism had disappeared in the 11th century and he was evidently misled on this point as the traditions relating to Nágúrjuna had at that distance of time become very vague. This will be clearly seen from what Prof. Sachau says in the preface to the Arabic edition of Albérúní.

"Its civilization was then essentially Brahminical as it had come to be in a protracted struggle with Buddhism. Albérúní does not know Indian Buddhism from personal experience, though it had not yet entirely withdrawn from India and in some part was still a political power. (p. v.)

"The valley of the Kábul river and the Punjab are all that Albérúní has seen of India. (p. xiii.)

"The high schools of Hindu science and learning, Kasmir and Benares, were in Albérúní's time unapproachable for Muslims. (p. xiv.)"

From the time of Nágírajuna onwards Ma-
 háyánism began to be tinged
Asamga. more and more with Brahmi-
 nical bias. A notable and decided step in
 this direction was taken by *Asamga*, a monk
 of Gándhára, who composed the *Yogáchára-*
bhúmisástra, in which by assimilating the
 doctrines of Patañjali he paved the way for
 the growth of the Tantras. He seems to
 have lived about 400 A. D.* *Vasubandhu*,
Asamga's younger brother, was another zea-

* Cf.—Takakasu : Journ. Roy. As. Soc. Jan. 1905.

A life of *Vasubandhu* was translated into Chinese by
Paramártha. A. D. 557-569.—Bun. Nanj. Cata. p. 371.
Csoma Korosi following the Tibetan Chronology says :—" I
 know that *Arya Asamga* lived in the sixth or seventh century
 after Jesus Christ." As. Res. XX, p. 513. This date has
 been accepted by Lassen (*Ind. Alt.* ii. p. 460) as also by
 R. Davids (*Buddhism*. p. 207). But this chronology has
 now become untenable. The date of *Asamga* and his
 brother *Vasubandhu* should be put back by about two cen-
 turies, as some of their works were translated into Chinese
 in the beginning of the fifth century and perhaps earlier.
 (Bun. Nanj. Cata. App. i p. 371). It must have taken a
 century or two to have their works sufficiently recognised
 in India before they would deserve a place in the Chinese
Tripitaka.

lous adherent of this school and is said to have been a teacher in the college attached to the monastery of Nálendra—the “Oxford of Indian Buddhism.” From Tibetan sources we learn that the celebrated logician Dignága was a disciple of Vasubandhu, a contemporary of Lha-tho-ri, king of Tibet, who lived up to 371 A. D. *

Maháyánism now began to adapt itself to its environments. The absorption of the Yoga ideas made the transition into the Tantric cult easy and Nor-

Gradual and imperceptible fusion of Maháyánism with Saivism.

thern Buddhism began to develop and expand by entering into an alliance with Saivism, which favored the growth of Buddhist Tantras. The origin and development of this class of literature have been the subject of a masterly exposition by Burnouf. The Maháyánists not only set up their own deities but borrowed copiously from the pantheon of the Hindus. Thus in the Sivaite Tantras while

* S. C. Vidyábhúshana : Journ. As. Soc., Vol i, (1905), p. 227.

the God Siva is the fountain of all knowledge and sciences, in their Buddhist counterparts we have the celestial, metaphysical and potential Buddhas * occupying the same position. The worship of the female energies (Sakti) which plays such an important part in the Tantras was encouraged in the person of Tárá. The Hindu Gods and Goddesses were also objects of adoration, only they were assigned a subordinate position. The question has often been asked : why did Buddhism seek alliance with Saivaism in preference to the Vishnuvite cult ? The answer seems to lie in the fact that it was precisely in those parts of India where the worship of Siva, especially in its Tántric form, had struck root that Maháyánism asserted its sway ; † and thus the apostles and propagators of the latter made most of the former. A few centuries later when Vaishnavism gained an ascendancy in Bengal the tables seem to have been turned. A gradual and imperceptible fusion

* *i. e.* the Bodhisattvas.

† *Vide ante*. p. xi, (under Wema kadiphses).

took place between the rival creeds. Thus in the celebrated adoration in the opening lines of *Gítāgovinda* we find **Buddha** freely acknowledged as an incarnation of Vishnu and extolled for his abhorrence of sacrificial rites. *

From Fah-hian's travels we gather that in the beginning of the 5th century A. D., the Maháyānists were gaining the upper hand, though their rivals, the Hínayānists, were still holding their own in several localities. Thus at Mathurá and Pátaliputra he found the members of both the sects living side by side and having monasteries of their own.

* निन्दसि यज्ञविधेरहं युतिजातम् सदयहृदयदर्शितप्रयुजातम् । केशव
धृतबुद्धशरीरं जय जगदीश्वरे ॥

It is scarcely correct to assert that Buddhism was exterminated in the land of its birth by cruel persecution. Cf. Vol. i. Intro. lxvii. The Bengali poet Ramchandra Kavibharatī, author of *Bauddha Sataka*, though a devoted Buddha, belonged to the same class of thinkers as Jayadeva. Pandit S. P. Sāstrī is inclined to place him in the latter end of the 13th century.—*Journal of Buddhist Text Society*, Vol. I, Pt. iii. So late as 1441 A. D. MSS. of Buddhist works used to be copied from in Magadha.—Bendall's *Camb. Cata. of Bud. Sans. MSS.* (1883), Pref. iv.

From the fact, however, that the pious-Chinese pilgrim repeats the *Suramgama Sūtra* for his protection, we may conclude, since he is by no means a pronounced Maháyánist, that the predisposing causes for the origin of the Tantras were already in existence. "In this Sūtra is contained the most complete list of Dháranís (invocations) found in any Chinese compilation. There are 426 distinct sections containing the names of the different Buddhas and Hindu deities worshipped at the time of the composition of the Sūtra. Considering that Fah-hian in the early part of the 5th century regarded this book with reverence. We may reasonably assign it to a period not later than the end of the 1st century. Now amongst the invocations we find distinct reference to Dhyáni Buddha, Vairochana, Akshobhya, Amitábha and others shewing that they were coming to be recognised and worshipped even at that early date." *

* Intro. to Beal's "Fah-hian." (Lxxii).

These Dháranís may be looked upon as the precursors of the Tantras and they fully support the views that when they were composed Buddhism had turned a new leaf. The repeating of certain magic formulas along with the names of Buddha Amitábha, etc., was to secure salvation, in other words, “instead of the old doctrine [of *Karman*]—as a man soweth, so he shall reap—a new and easier way of salvation is here preached. *viz.*, as a man prayeth, so he shall be saved. It is what is known to us as salvation by faith rather than by works. It would almost seem as if this popular and easy doctrine had secured to itself the name of Maháyána, as meaning the Broad Way, in opposition to the Narrow Way, the Hínayána.*

The new class of literature which now arose in order to meet the demands of the Maháyánist revival is collectively known as

* Max Müller, *Buddhist Maháyána Sūtras*. Intro. to larger *Sukhávati-Vyúha*, ix, S. B. E. Series, Vol. xlix.

the Vaipulya Sūtras or the Sūtras of the developed school, of which the Dhāranīs are an integral part. It found expression in such works as the "Saddharmapundarīka," "Lalitavistara," "Tathāgataguhyaka," "Prajñāpāramitā," etc., —all of which soon acquired almost canonical sanctity in the estimation of the N. Buddhists. Burnouf has tried hard to differentiate between the simple Sūtras as represented by the literature of the primitive orthodox Buddhism and the expanded Sūtras of which the distinguishing mark is the occurrence of Bodhisattvas.* This drawing of hard and fast

* "La présence des Bodhisattvas ou leur absence intéresse donc le fonds même des livres où on la remarque, et il est bien évident que ce seul point trace une ligne de démarcation profonde entre les Sūtras ordinaires et les Sūtras développés. —Burnouf, Intro. p. 112; *ibid.*, p. 120. Ed. 1844. *Vide* Max Muller's remarks at the end of the Smaller Sukhāvatī-Vyūha, p. 102, S. B. E. Series, Vol. xlix.

Cf. also "Some Vaipulyas are, materially, much like the old Sūtras, whole passages e. g. of Lalita-Vistara recur almost word for word in the Pāli Scriptures," Kern (Ind. Bud., p. 5). This eminent Buddhist scholar also very appositely re-

lines has been found to be well nigh untenable. *

By the second century A. D, we find the leading beliefs and ideas as crystallised in the Maháyána literature fully in vogue. Thus we

marks elsewhere : "The results arrived at by Burnouf may be right so far as Mahávaipulya Sûtra as a whole is concerned, they cannot be applied to all the component parts of such a work. Not to go further than the Saddh. and the L. Vistara, it can hardly be questioned that these works contain parts of very different dates, and from various sources." Kern—Intro. to Saddhar, pp. x-xi. Passages in L. V. are literally identical with those in Mahávagga. Again :—"These few examples I have chosen will suffice to prove that the material of a Mahávaipulya Sûtra is partly as old as that of any other sacred book of the Buddhists."—*ibid*, xiv.

* The truth seems to be that "the historical relation between the Hínayána and the Maháyána schools of Buddhism is to me as great a puzzle as ever."—Max Muller, Intro. to L. Sukh. Vyúha, ix. Even the very distinction between the N. and the S Buddhism has been taken strong exception to by R. Davids, who says :—"There is not now and never has been, any unity either of opinion or of language in what is called northern, or in what is called southern Buddhism. There is a distinct disadvantage in continually suggesting a unity which has no existence in fact. In a word the current division of Buddhist literature into northern and southern is entirely unscientific, and misleading."—Bud. India, p. 173.

* come across in the "Buddhacharita" of Asvaghosha, who is admitted on all hands to be a contemporary of Kanishka, such a passage as this: "this, Sirs, is the Maháyána, the instrument of the law of the perfect Buddha, which is the establisher of the welfare of all beings, set forth by all the Buddhas." * The "Lotus of good Law" was translated into Chinese at the close of the second century A. D. †

Side by side with the growth of the scriptures another class of literature was called into being by the exigencies of the times—we mean the ^{Buddhistic Tan-} ^{tras.} Tantras, the necessity for which has been hinted at in the first volume. ‡ However esoteric may be the doctrines sought to be conveyed through the medium of these productions, it would be idle to deny that there

* Cowell's trans. p. 184. S. B. E. Series, Vol. xlix.

† Edkin's "Chinese Buddhism," p. 89. There were several versions of this sacred book,—*Vide* Kern's Intro. p. xxiii (S. B. E. Series).

‡ Vol. i, Intro. lxx.

is much in them which is calculated to pand^{er} to the baser instincts of frail humanity. At what particular time these Tantras appeared on the scene is yet a matter of conjecture, but the views of Wilson which held the ground for more than 30 years have now been found to be erroneous. Evidence is now forthcoming from quite an unexpected source, which goes to prove that Buddhist Tantras existed as early as the fifth or sixth century A. D., if not earlier. * If Buddhist Tantras, again, pre-suppose the existence of Hindu Tantras, one need not be considered as rash in assigning an earlier age to the latter. †

* *Vide* the palm-leaf MSS. discovered in the monastery of Horiuzi in Japan and carried from Central India. One of these is in the handwriting of a famous Chinese priest, named Kanshin, who came to Japan in A. D. 753. The MS. contains besides a Dháraní, five Tantras. "Bud. Texts from Japan," ed. by Max Muller. Vol. i, pt. i. Intro. pp. 6-8. It is fair to conclude that these Tantras existed in the land of their birth at least two centuries earlier.

† Waddell says :—"No one has yet realised the vast extent to which Maháyána and Tántric Buddhist remains cover India ; nor sufficiently realised the leading part played by the Maháyána in Indian Buddhism during its popular period." *Journal of the Roy. As. Soc.* (1894).

The Tantras found a congenial home in China. Amoghavagra, a Sramana of northern India and a Brahmin by caste resided in the Celestial Empire for several years between 746 and 771 A. D., and under his influence the Tantric doctrines dealing with talismanic forms and professions of supernatural power first gained currency there.* Hence long before his time Tantras must have been popular in India. From the eighth to the eleventh century A. D. we are in possession of authentic records as regards the prevalence of Tantras in Northern

Tantras imported
into Tibet.

India ; as it was about this period that several of these were gradually imported into Tibet by Indian Pandits, but they must have been composed much earlier. †

* Bun. Nanjio's Cata. App. ii, p. 445 Amoghavagra translated 77 works including *Ushnīsha-chakravartī-Tantra*, *Garudagarbhaga-tantra* and *Vagrakumāra-tantra*.

Cf.—Also "The existence of the Tantra Śāstras may thus apparently be traced at least as far back as the 6th century A. D."—*Vide* "Annual Report," As. Soc. Beng. 1906.

† In the first half of the eighth century two eminent

Atisa gave a fresh impetus to Tantrism in the land of snow. From the analysis of Mdo by Csoma we also come to know in detail the names with the dates of the Indian scholars who with the aid of the local interpreters (*lochavas*) rendered into Tibetan the various Sanskrit Tantras. The faithful accuracy with which these translations were made and their fidelity to the original enable us often to reproduce the Sanskrit Texts and thus we are in possession of valuable histori-

Pandits of Bengal visited Tibet at the invitation of its king and formally introduced there Buddhism ; these Pandits were Śānti Rakshita, high priest of the monastery of Nálenda and his co-adjutor Padma Sambhava, a native of Udyana, who took charge of the Tantric part of the Buddhist liturgy. They were followed by the sage Dípamkara-Srí-jnána (Atisa), b. A. D. 980, d. 1053. He acquired proficiency in the three píṭakas of the four classes of the Hínayána Śrávakas, in the Vaisesika philosophy, in the three píṭakas of the Maháyána doctrine, the metaphysics of the Mádhyamika and the Yogáchárya schools and the four classes of the Tantras. At the request of king Naya Pála he accepted the post of high priest of the monastery of Vikramasíla,—*Vide* S. C. Dás,—Journal of the Buddhist Text Soc. Pt. i.

cal data.* Some of these Tantras deal with alchemy and their contents reveal to us the knowledge of chemical processes in India from about the 6th to the 8th century A. D.†

Fortunately we are not dependent upon the Tibetan Tantras alone for gaining an insight into this dark recess in the history of Hindu intellectual activity. In the course of our search

Rasaratnākara.

* Speaking of the Tibetan translation of Asvaghosha's *Buddha-Charita*, Cowell remarks: "The Tibetan version appears to be much closer to the original Sanskrit than the Chinese; in fact from its verbal accuracy we can often reproduce the exact words of the original, since Sanskrit words are always represented by the same Tibetan equivalents, as for instance the prepositions prefixed to verbal roots."—l. c. Intro. p. x. Waddell is equally impressed with the "profoundly accurate and scholarly nature of the Lāmaist translations of Sanskrit Buddhist books;" and he again observes: "It is clear that the Tantric and Mahāyāna features of Lāmaism were imported *en bloc* from Indian Buddhism."—*Journal of the Royal As. Soc.* for 1894, p. 15.

† Analysis of the contents of the Mdo (Sūtra) by Csoma de Korösi—*Asiatic Researches*, XX (1836), p. 583. "A work on preparing quicksilver, the most powerful for subduing every sickness and for improving the vigor of the body."—"A work on turning base metals into gold." We are thus reminded of the contents of the *Rasārṇava* and the *Rasaratnākara*. *Vide* p. 2.

for MSS. of alchemical Tantras we have come upon a precious find, in the shape of a Buddhist Tantra, with Nāgārjuna as its reputed author. Of alchemical Tantras we have had enough and to spare; but there is great difficulty in assigning dates to them, as they one and all pretend to emanate from the mouth of the God Siva himself. We are only left to internal evidences—evidences based upon the gradual evolution of chemical processes, which we have not been slow to take advantage of. The MS. in question is a mere fragment, but it is calculated to

Its historical importance. evoke all the zeal and enthusiasm of a Palæontolo-

gist—of an Owen or a Marsh—in his efforts to restore an animal and assign to it its proper place in the economy of the laws of evolution, when he luckily chances upon a fossil impression of its tooth or claws. From this point of view Rasaratnākara, for such is the name of our MS., is of uncommon interest. It is a Tantra of the Mahāyānist school and as such its invocations are

addressed to all the Buddhas ; * and in one place there is a pointed reference to Prajñá-páramitá † (perfection of wisdom). appearing before Nágárjuna in a dream and revealing to him chemical knowledge. ‡

A noteworthy feature of this work is that some chemical processes are discussed in the form of a dialogue between Sáliváhana and Nágárjuna, and Ratnaghosha and Mándavya. § These last two names are held equally in veneration with Nágárjuna and grateful acknowledgments to their services occur in some later chemical treatises. ¶ The bringing together of these four *dramatis personæ*,

* प्रणिपत्य सर्व्वबुद्धान् । Cf. The opening invocation in the Sukhávatí Vyúha : ओं नमः श्रीसर्व्वबुद्धान्बोधिसत्त्वैभ्यः । also नमः प्रत्येकबुद्धान् आर्य्यावकाशान् नमो बोधिसत्त्वानाम् in Arya Manjusrí-múla Tantra.—Vide As. Res. xx, p. 512.

† Cf.—The invocation in Vagrachchediká : नमो भगवत्या आर्य्यप्रज्ञापारमितायै.

‡ Vide Sans. Texts, p. 10, also Trans. p. 5.

§ Vide Sans. Texts, pp. 12-14, also Trans., pp. 6-8.

¶ Cf. Vol. i, p. 77.

especially of the first two has a significance of its own. We have already seen that references to Nágárjuna and his contemporary king Śáliváhana are only to be met with in ancient classical literature (*vide ante* xxii). It seems probable that Rasaratnákara was written at a time when the memory of these personages was still fragrant. Judging from internal evidences also we come to the conclusion that it is one of the earliest works extant on the subject. In our attempt at throwing light on the text of Rasárnava, we had to quote several parallel passages from it, * and from a careful perusal of both we are

Also a typical production of the Maháyánist period of intellectual activity.

of opinion that the latter is the inspirer rather than the borrower. Rasaratnákara, in short, seems to us to be a typical production representing the Maháyánist period of intellectual activity and we may not be wide of the mark if we put down 7th or 8th century A. D. as its latest date.

* *Vide* Vol. i, Sans. Texts, pp. 7, 12, 13 and 18.

From the 5th to the 11th century A. D. the colleges in connection with the monasteries of Pátaliputra, Nálandá, Vikramasíla, Udandapura, etc., were the great seats of learning as the temples attached to the pyramids in ancient Egypt; and alchemy was included in the curricula of studies. *

The existence of a vast ancient Tantric literature with alchemy as a component part has now been placed beyond doubt, thanks to the searching examination of the Mahárájá's collection of valuable MSS. of Nepal by the eminent scholars Bendall, H. P. Sástrí and S. Lévi. Of surpassing interest is the discovery of a Tantra belonging to the extinct school Kubjikámata, written in Gupta character and copied about the sixth century A. D. This

* Cf. "By the side of the tower of king Asoka is built a Samghavása, belonging to the great vehicle, very imposing and elegant. There is also a temple belonging to the little vehicle.....In the college attached to the temple one may see eminent Sramanas from every quarter of the globe."—Beal's "Fah-hian," ed. 1869, p. 105.

school, though itself very ancient, presupposes the existence of other schools and we have distinct mention of the Maháyána.* We now learn that the gradual fusion and amalgamation of Sivaite and Buddhist Tantras had begun even anterior to the sixth century. The Kubjiká-tantra was evidently composed outside India proper, probably in Nepal. The Goddess Párvatí encourages her consort to proceed to the continent for the spread of the tenets propounded by it.† In one place we come across a passage‡ in which Siva himself speaks of párada (mercury) as his generative prin-

* Catalogue of Palm-leaf and selected paper MSS. belonging to the Durbár Library, Nepal, by H. P. Śāstrī (1905). lxxviii, *et. seq.*

दक्षिणे देवयानी तु पिष्टयानसद्योत्तरे ।

मध्यमे तु महायानं शिवसेना प्रतीयते ॥

† गच्छ त्वं भारते वर्षेऽधिकाराय सर्व्वतः ।

‡ महीर्थः पारदो यद् पतितः स्फुटितं मणिः ॥ * * *

महीर्थेण प्रसूतास्ते तावार्था सूनके वदि ॥

तिष्ठन्ति संस्कृताः सन्तः भव्या षड्विप्रचारणाम् ॥

For the passages cited here we are indebted to the industry and courtesy of Pandit H. P. Śāstrī, who has wended his way through the bulky MS.

ciple and eulogises its efficacy when it has been killed six times. * We also find allusions to the transmutation of copper into gold with the aid of mercury. In short, we have ample references to alchemical processes described in the very technical terms in which *Rasárnava*, *Rasaratnākara* and other typical works of the Tantric period abound. †

It is now only necessary to wind up this chapter with an extract from the work of an eminent Buddhistologist with this reservation that the growing influence of Tantrism began as we have seen long before the 8th century.

“The decline of Buddhism in India from the 8th century downwards nearly coincides with the

* Even at the present day mercury, which has been *killed* six times in succession, each time with an equal weight of sulphur *षड्गुणबलिजारित*, is reputed to be one of the most potent of remedies.

† e. g. पक्षेन विद्धिती वेधः किं व्यञ्जतो न विध्यते ।

रसविद्धं यया तासं न भूयसासतां व्रजित् ॥

For the meaning of the word वेध (Vedha) see this Vol. p. 18, *footnote*, also Vol. i, p. 120.

growing influence of Tantrism and sorcery, which stand to each other in the relation of theory to practice. The development of Tantrism is a feature that Buddhism and Hinduism in their later phases have in common. The object of Hindu Tantrism is the acquisition of wealth, mundane enjoyments, rewards for moral actions, deliverance, by worshipping Durgā, the Sakti of Siva—Prajñā in the terminology of the Mahāyāna—through means of spells, muttered prayers, Samādhi, offerings, etc. Similarly the Buddhist Tantras purpose to teach the adepts how by a supernatural way to acquire desired objects, either of a material nature, as the elixir of longevity, invulnerability, invisibility, alchemy ; or of a more spiritual character as the power of evoking a Buddha or a Bodhisattva to solve a doubt, or the power of achieving in this life the union with some divinity. There is an unmistakable affinity between Tantrism on one side, and the system of Yoga and Kammattḥāna on the other. Tantrism is, so to say, a popularised and, at the same time, degraded form of Yoga, because the objects are commonly of a coarser character, and the practices partly more childish partly more revolting.

“ Tāranātha informs us that Tantrism existed and was transmitted in an occult manner in the period between Asaṅga and Dharmakīrti, but that after

Dharmakīrti's times the Anuttarayoga became more and more general and influential. Substantially his statement is certainly right. He adds that during the reign of the Pāla dynasty, there were many masters of magic, Mantra-Vajrāchāryas, who, being possessed of various Siddhis, performed the most prodigious feats.

"The kings of the Pāla dynasty, whose sway over Gauda and the adjacent regions lasted from about A. D. 800 to 1050, are known both from the annals and their inscriptions as protectors of the Faith. It was during that period that the monastery of Vikramasīla was a renowned centre of Tantrist learning.

"The Sena kings, who followed the Pālas in the dominion over Eastern India, though belonging to a Hindu persuasion, were not hostile to the Faith. Still Buddhism declined during their reign and more so after the invasion of the country by the Muhammedans in A. D. 1200. The monasteries of Udandapura and Vikramasīla were destroyed; the monks were killed or fled to other countries. The learned Śākyaśrī went to Orissa, and afterwards to Tibet; Ratnarakshita to Nepāl; Buddhāmītra and others sought a refuge in S. India, whilst Saṅgama-Srijñāna with several of his followers betook themselves to Burma, Camboja, etc. And thus the Law of Buddha became extinct in Magadha.

"Many emigrants from Magadha rejoined their brethren in the South and founded colleges on a modest scale in Vijayanagara, Kalinga, and Konkan. The comparatively satisfactory condition of Buddhism in Dekkhan about that time is attested by the rich donations to the monastery at Dambal." *

It will be noted that the monks of the monasteries of Udandapura and Vikramasila on their dispersion carried with them their learning and arts in the same manner of the

Spread of al-
chemy.

Byzantine Greeks on their expulsion from Constantinople bore with them their intellectual treasures to the Italian cities. In the kingdom of the Deccan and in Tibet the Buddhist refugees found hospitable asylums,† just as the Greek Philosophers did in the Florentine Republic under the Medicii.

Some eminent orientalists, whose opinions naturally carry weight, have hitherto taken

* Kern—Manual of Ind. Bud., pp. 133—134.

† Cf.—"The Deccan, which from the eleventh century was the refuge and centre of literary activity generally. In Hindustan it had been substantially arrested by the inroads and ravages of the Muhammadans."—Weber. Hist. Ind. lit. p. 283.

for granted that the knowledge of chemistry such as we find reflected in the Tantras quoted by Mádharma in Rasesvaradarsana* was derived by intercourse with the Arabs. †

* Vol. i, Intro. lxxviii. *et seq.*

† E.g. Barth : "In regard to alchemy, anyhow in which the Sittars are zealous adepts, they were disciples of the Arabians, although other Sivaites had preceded them in the pursuit of the philosopher's stone. Already, in his exposition of the different doctrines of the Saivas, Sáyaṇa thought he ought to dedicate a special chapter to the *Rasesvara-darsana* or "system of mercury," a strange amalgamation of Vedantism and alchemy. The object contemplated in this system is the transmutation of the body into an incorruptible substance by means of *rasapāna* i.e., the absorption into it of elixirs compounded principally of mercury and mica, that is to say, of the very essential qualities of Siva and Gauri, with whom the subject of the operation is thus at length identified. This species of transubstantiation constitutes the *jīvanmukti*, or state of deliverance commencing with this present life, the sole and indispensable condition of salvation. It is clear that the devotional formulæ of the Vedānta are here only a sort of jargon, under which there lies hid a radically impious doctrine; and it is not less clear that in this doctrine, which had from the fourteenth century produced a rather considerable literature, there is an infusion of Mohammedan ideas. The Arabs of the Khalifat had arrived on these shores in the character of travellers or merchants, and had established commercial relations and intercourse with these parts long before the Afghans, Turks, or Mongols, their coreligionists, came as conquerors."—"Religions of India," ed. 1891, pp. 210-211.

The attentive reader who has followed us all along could not have failed to notice that it was in the Universities of Nálendá, Udandapura and Vikramasíla, in Central India and Magadha, precisely the regions which were cut off from communication with the external world, that Tantric mysticism with alchemy as an integral part was cultivated and from thence spread to Bhot (Tibet) and the regions lying to the south-east of it, * and South India. †

* See under colophons to *Rasahridaya* and *Rasasāra* respectively.

† The last rallying point of Hindu learning and sciences was the kingdom of Vijayanagara, which was in the heyday of its glory under Bukka I (A. D. 1354-1371) with Múdhava as his prime Minister. Wilson says :—"The history of Vijayanagara is a subject of considerable interest in the annals of India, as the last barrier that was opposed to Muhammedan invasions, and that preserved the southern part of the Peninsula from foreign rule until a very modern period."—*As. Res.* Vol. xx (1830), p. 1. See also Sewell's "A Forgotten Empire."—(Vijayanagara).

CHAPTER II.

Having thus far prepared the ground for believing that alchemy along with other cognate branches of learning was the outcome of Indian intellectual activity, we shall now proceed to follow it up with its further development. At the outset it is, however, necessary to remember that on the decline of Buddhism the vigorous impetus which its followers gave to literature and science was not lost to India. Nay, during and after the revival of Brahminism under the Gupta dynasty and its successions we have some mighty intellectual giants whose productions will continue to shed lustre as long as the Hindu nation exists. Kálidása and Bhavabhúti, Brahma Gupta and Aryabhata, Samkara and Rámánuja are names which may be regarded as the heritage not of India alone but of the entire civilized world. At the time of the Brahminic revival Buddhist works of acknowledged merit far from

Further cultivation of alchemy.

being cast aside were held in veneration. Amarasimha in his Lexicon and Vágbhata in his *Ashtāṅgahrīdaya* * as also the psuedo-Vágbhata * commence with an invocation to Buddha, which has never shocked the tolerant spirit of the Hindu. Charaka and Susruta also bear distinct impress of Buddhist retouching. The Buddhist Tantras became likewise a part and parcel of Hindu religio-philosophical literature, † the subject-matter

Buddhist alchemical Tantras absorbed into Hindu Tantras.

of the former was incorporated into the latter, the names of Tára, Prajñáparamitá and Buddha being simply changed into those of Párvatí and Siva. In *Rasaratnákara* itself we have distinct indications that it is an admixture of both.

* Vol. i, p. 76.

† Speaking of a typical Buddhist production belonging to this category Burnouf observes: "Ce morceau est exclusivement spéculatif, et il nous'offre une nouvelle preuve de l'alliance intime que le système des Tantras a contractée avec la philosophie buddhique la plus élevée." (l. c. p. 543 ed. 1844).

It should thus be understood that the works under review in this chapter are based upon their Buddhist counterparts; in short, there is no disposition to ignore the debt of obligation the authors are under to Nágá-rjuna, Ratnaghosha, Mándavya and others.

In the introduction to the first volume we stated : " It is to be regretted that of the several works quoted by Mádhava [on the science of mercury] Rasárnava alone seems to have survived to our days " (l. c. lxxxiii). Since then we have been fortunate enough to procure as many as three transcripts of MSS. of Rasahrída-ya by Govindabhagavat from different quarters. As Mádhava speaks of this author in terms of the deepest reverence and regards him as " ancient," * we think we should not err on the wrong side if we place the author some three centuries before his time. If our surmise be

* Cf. Vol. i, Intro. lxxx.

तत्प्रपञ्चस्तु गोविन्दभगवत्पादाचार्यसर्व्वज्ञरामेश्वरभट्टारकप्रभृतिभिः
प्राचीनैराचार्यैर्निरूपितः ।

The qualifying epithet भगवत् is only applied to venerable Rishis of old.

correct, he should have lived about the eleventh century A. D. The only personal allusion which the author has condescended to offer for the edification of posterity is that he wrote his book at the request of the king of the Kirátaland, *i.e.*, the region adjoining modern Bhotan. Portions of this remarkable treatise after a careful collation of three MSS. have been reproduced in the proper place. The worm-eaten fragmentary MS. procured from Benares is 386 years old. Internal evidence equally goes to establish the antiquity of this work. The author was evidently a Buddhist as we learn from the colophon to the Benares MS. (*vide* trans. p. 12). It is, however, not to be found either in the India office or the Nepál MS. This important omission is easily accounted for. It is the reluctance of the latter day Hindus to acknowledge their obligations to a Buddhist author.

Rasárnava which has been noticed at length in the first volume and to which was assigned the 12th century A. D., as also Rasaratna-samuchchaya, (13th to 14th century), need not further arrest our attention.

The presentation of the various treatises of the Tantric and iatro-chemical periods under discussion in their exact chronological sequence is not an easy task; in the absence of more definite information, we are afraid, we shall now and then have to hazard a conjecture.

The introductory lines of Books viii and ix of *Basaratnasamuchchaya*, in which Somadeva is mentioned as the author of the descriptive part, led us to suspect that they are merely reproductions from "a standard work on the subject by Somadeva, no longer extant."*. Our surmise has proved to be

Rasendrachūdā- partially correct. We have
mani. at last been able to recover

the supposed lost work. A transcript of a MS. of *Rasendrachūdāmani* by Somadeva, preserved in the Library of the Deccan College, Poona, reveals to us the fact that practically all the important portions of this book have been woven into the text of *Basaratnasamuchchaya*; and this gives us

* Vol i, p. 118.

an additional opportunity of collating many doubtful passages in both. But the present work itself does not lay claim to originality. It makes a candid admission that it culls all its materials from pre-existing chemical treatises.* It further puts forward the alchemist Nandi as the inventor of the process of sublimation and of the *Koshtī* apparatus (Vol. i, pp. 69 and 89).† *Nágárjuna*, *Dandī*, *Sambhu* and the sage *Brahmajyoti* are also spoken of as sources of his inspiration. We get very little inkling into the personal history of *Somadeva*, except that he was the ruler of a city named *Karaválabhairava*. The fact that *R. R. S.* lays *Basendrachūdāmani* so amply under contribution would suggest that the latter had become somewhat rare or that its contents had been well nigh forgotten when the former was compiled. Its date may therefore be put down between the 12th and 13th centuries A. D.

* अथ यन्त्राणि वक्ष्यन्ते रसतन्त्राख्यनेकाग्रः ।

समाश्लोक्य समासेन सोमदेवेन साम्प्रतम् ॥

† ऊर्ध्वपातनयनं हि नन्दिना परिकीर्तितम् ।

कीडिकायनमेतच्च नन्दिना परिकीर्तितम् ॥

Another important work of this period is *Rasaparakāsa-sudhākara* by Yasodhara. The author of R. R. S. in the opening lines mentions the names of 27 alchemists to whom, he is beholden, among which occurs that of Yasodhana. We have little doubt the correct

Rasaparakāsa-sudhākara.

reading is Yasodhara. We now find that there is very little original matter in R. R. S., it being made up of citations from *Rasārṇava* and the works of Somadeva and Yasodhara. We should not, however, be understood to retract the high encomiums we thought fit to bestow upon R. R. S. for "its methodical and scientific arrangements of the subject-matter, which would do credit to any modern work."* Its author has never laid claims to originality, but on the contrary has freely acknowledged the sources he drew upon. The student of Hindu chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths and feel ineffable joy at being able to approach the original

* Vol. i, Intro. lxxxvi.

fountain undefiled. It now transpires that the credit for the accurate observations on the metallurgy of zinc (Vol. i, pp. 88 & 156) really belongs to Yasodhara. While the author of R. B. S. always scrupulously admits that his work is a mere compilation, Yasodhara, on the other hand, is anxious to let the world know that the processes he describes have been verified by experiments performed with his own hands. * Among the authorities he cites are Nágárjuna, Devísástra (probably Rasárnava), Nandi, Somadeva, Svachchhandabhairava and Manthanabhairava. As Yasodhara quotes Somadeva, he must have been posterior to the latter by at least a hundred years and he should therefore be placed in the 13th century A. D. †

* Cf. खड्गलेन कृतं सम्यक् कारणं न श्रुतं मया ।

खड्गलेन भवयोगेन कृतं सम्यक् श्रुतेन हि ॥

धातुबन्धस्थतीयोऽसौ खड्गलेन कृतो मया ।

दृष्टप्रत्यययोगोऽयं कथितो नात्र संशयः ॥

† We are using a copy of the MS. preserved in the Runbír Library, Kásmír. The readings are on the whole accurate.

Rasakalpa likewise seems to belong to this period. It is in the shape of

Rasakalpa.

a Tantra, but curiously enough

it is not much troubled with consistency. In the opening salutation Siva, "the king of mercurial lore" and his consort *Chandiká* are reverentially bowed to—a procedure scarcely reconcilable with the position of a revealed document. The colophon at the end of each Chapter (उद्देश) claims the work to be a part and parcel of *Rudrayámala Tantra*; at the same time due acknowledgment is made to the contributions of Govinda, the author of *Rasa-hridaya*, *Svachchhandabhairava* and other adepts. * Towards the end the author says: "The processes described have all been verified by me and not borrowed at second-hand from my teachers." Needless to add here that the God Siva would not have been at pains in justifying the necessity of his production with such a timorous apology. From internal evidence it is abundantly clear that it could not have been composed earlier than the 13th century A. D.

* E. g. सर्वपापार्थोदोक्तिः ।

As the author has confined himself solely to a description of the metals, minerals and the processes of "killing" them with the agency of various apparatus and has not gone into the treatment of diseases with the aid of mineral preparations, he has been able to condense much important information within the narrow compass of a few short chapters.

Rasarājalakshmī also deserves some prominence here, not because of its intrinsic worth but because of the references to previous Tantras and alchemists, amongst which are Rasār-
 Rasarājalakshmī. nava, Kākachandīśvara, Nāgārjuna, Vyādi, Svachchhanda, Dāmodara, Vāsudeva and Bhagabat Govinda. We have also categorical mention of the purely Ayurvedic works, such as Charaka, Susruta, Hārīta and Vāgbhata, to which our author is equally indebted.* From the colophon to the MS. procured from Benares we learn that the author Vishnudeva

* *Vide Sanskrit Texts*, pp. 80-81.

was Court Physician to king Bukka. * If this statement be accepted—and *prima facie* there is no reason to question it—this treatise must have been compiled in the latter part of the 14th century. Internal evidence equally supports this date.

* *Vide ante.*, footnote, xlix.

CHAPTER III.

C. 1350 A. D.

We now proceed to examine the contents of another series of works belonging also to the Iatro-Chemical period ; the one characteristic feature of which is that opium is recognised as an official drug in the materia medica portion. These may be taken to date from the middle of the 14th century A. D.

Rasanakshatramúliká by Mathanasimha, physician to the king of Malwa, should find a place in this chapter. For particulars as to the contents the reader may consult p. 22. The date given by the copyist of the MS. is Samvat 1557 i.e. 1500 A. D. The work itself is therefore older.

Rasaratnákara by Siddha Nityanátha, son of Párvatí, comes under this category. * The author gives the sources of his information and explains the object of his compila-

* Two editions of this somewhat voluminous work have been published—one by Ganesa Chandra Ghose (Calcutta),

tion in the following words : “ Whatever has been revealed by Siva in Rasárnava under the preparations of mercury ; the Dípiká of Rasamangala on mercury ; all that has been said by Nágárjuna for the benefit of people afflicted with diseases, as also by Siddha Charpati, by Vágbhāta and Su-sruta,—all these and many other treatises on mercury and minerals being consulted, I have, after rejecting the drugs and medicaments which have become rare and difficult to procure, put together [in my work] the essential features thereof. * * * * All that I have learned from my teachers and have been in a position to subject to practical tests has been incorporated into my work for the benefit of mankind.” In addition to the authorities cited above Nityanátha quotes from Chakrapáni and Rasendrachúdamani (*ante liv*).

the other at the “ Venkatesvara Press ” (Bombay). We have compared the readings of these two editions with the MS. in the Library of the Sanskrit College, Calcutta. They agree fairly well.

Rasendrachintámani will next claim our
 Rasendrachintá- attention. We have before
 mani. us the printed copy, edited by

Umesa Chandra Sena Gupta,
 late librarian, Sanskrit College, Calcutta, in
 which the text has been adopted, as the
 editor informs us in the preface, after colla-
 tion of 3 or 4 MSS. We have carefully gone
 over this edition and compared its readings
 with those of a MS. procured from Benares
 and another from the Runbír Library, Kásmír.
 All these agree in the main, but there happen
 to be certain omissions and additions, which
 form an interesting chapter in the history of
 interpolations in the literature of this descrip-
 tion. To begin with : there is a dispute over
 its very authorship. Some MSS. ascribe it
 to *Dhundhukanátha*, disciple of Kálanátha,
 others to Rámachandra. After the custom-
 ary salutation there occur two couplets in
 the Calcutta edition, which are not met with
 in the Benares and Kásmír exemplars. In
 these the author is made to justify his *raison*
d'etre for undertaking his task in these words :
 “ I shall give publicity only to such processes

as I have been able to verify by my own experiments." Such protestations have already been noticed more than once.* In another place we have : " Those mercurial operations alone have found a place in my book, which I have been able to put to tests. Those who teach without being able to perform experiments labour in vain." This last couplet is quite out of place as it hangs like a tail to a long extract from *Rasárnava* and is in fact conspicuous by its absence in the Benares and Kásmír MSS.† For the second time we find calomel designated as *Rasakarpúra* (lit. camphor of mercury ; *vide* vol. i, p. 250). This preparation no doubt occurs in the older

* Such pretensions put forth on behalf of the author, especially in the first person singular, lead one to suspect that they are later interpolations. In the Arabian alchemy Geber is often made to declare to the same effect : *c. g.* " J'ai expérimenté moi-même tout ce que je rapporte."—Berthelot, " *La Chimie au moyen Âge*," t. i. p. 338. The well known egoistic couplet in *Susruta*, Ch. i, अहं हि धन्वन्तरिरादिदेवो is generally regarded as an interpolation.

† The extract commences with त्वं माता सर्वभूतानां .

works, e. g. *Rasárnava*; but it is described there as the white "ash" of mercury (*sveta-bhasma*). The recipe for calomel as given in the Calcutta edition, however, is quite different from that in the Benares and Kásmír MSS. and it is altogether wanting in one of the MSS. in the Calcutta Sanskrit College Library. We are therefore not without suspicion that it has been foisted into the original composition. The author refers to *Declanava*, *Nágárjuna*, *Govinda*, *Nityanátha*, *prodha Lakshmívara*, *Trivikramabhatta*, *ajists of Chakrapáni*. There is a lengthy col that but no direct information can be derived, neg- it as to the age of the author. per

Rasasára: It is a comprehensive but purely chemical work dealing with 18 operations on mercury; various chemical processes are incidentally described, a good many of which, however, overlap each other. There does not seem to be any justification for coining a multiplicity of technical jargons to connote each of these. But prolixity was never regarded in the light of a vice by the

alchemical writers of the middle ages either in India or in Europe. The contents of Basasára often remind us of a poem on alchemy by George Ripley, canon of Bridlington in Yorkshire (b. about 1460), of which Rodwell says :—

t. "But we cannot point to a new fact which he
mei. ciculated. He divided all chemical operations
quite twelve processes—calcination, dissolution,
long eation, conjunction, putrefaction, congelation,
conspicbn, sublimation, fermentation, exaltation,
Kásmír lication and projection. Several MS. copies
find ca poem exist in the British Museum, bound up
camph. copies of the works of Roger Bacon and
This, er writers. Here is a specimen of his rugged
ymes :—

— The first chapter shall be of natural *Calcination* ;
The second of *Dyssolution*, secret and phylo-
sophycall ;
The third of our elementall *Separation* ;
The fourth of *Conjunction* matrimoniall ;
The fyfth of *Putrefaction* then followe shall :
Of *Congelation Albyficative* shall be the Sixt,
Then of *Cybaton*, the seaventh shall follow
next." *

The author, Govindáchárya, as a devout Hindu, begins with his adoration of Siva and Vishnu and tells us at the outset that his treatise is a compilation and epitome based upon standard works on the subject and the contributions of the adepts. We have every reason to be thankful to him for the many hints he throws on the sources of his information. Of surpassing interest is his declaration that for a knowledge of certain processes he is indebted to the Buddhists of Tibet.* This must be taken to mean that the cultivation of alchemy had become neglected and almost forgotten in India proper and the earnest searchers for this lore had to repair during the time of our author to Tibet. Confirmatory evidence to this effect is equally

* एवं बौद्धा विजानन्ति भाटदेशनिवासिनः ।

Towards the close of his work the author again acknowledges his obligation to the Buddhists.

बौद्धमतं तथा ज्ञात्वा रसमारः कृती मया ।

We have in our possession five transcripts of the MSS. of Rasasāra procured from the Libraries of Kásmir, Tanjore, Ulwar, Madras and the Temple of the Goddess Kālī, at Ramnā, near Dacca, Bengal.

furnished in the colophon to *Rasahridaya* (trans. p. 12). During the decadence of Buddhism and the corresponding ascendancy of Brahminism in Bengal, say about the 11th to 13th centuries A. D., this branch of science also found a safe retreat in the land of the Kirátas as we have already seen. Burnell, under the influence of his preconceived notion, namely that Indian alchemy owed its origin to the Arabs, very naively remarks: "By *Bauddhas* he (the author) probably means the Muhammedans (*cf.* the vernacular Malayálam use of the word), though studies of this nature were much pursued by the later Buddhists." *

Some idea of the date of *Rasasára* may be formed from the fact that there is mention of opium in it. But our author was evidently quite in the dark as to its origin; for, says he: "There are 4 different kinds of poisonous

* Catalogue of the Tanjore Palace MSS. pt. 1, p. 70. Burnell draws his conclusions from the reference to Buddhists in the colophon; but we have quoted above another passage in which distinct mention is made of the Buddhists of Tibet.

“sea-fish, and it is from their foam that 4 different kinds of opium are derived, namely, white, red, black and yellow; while others maintain that it is derived from the foam of the snake and it is very properly used for chemical operations,” * *e. g.*,—killing and fixation of mercury. From the context it is, however, doubtful if the narcotic drug is really alluded to here. But independently of the use of this term we may safely place this work in the 13th century A. D.

* समुद्रे चैव जायते विषमत्स्याश्चतुर्विधाः ।
 तेभ्यः फेनं समुत्पन्नम् अहिफेनो विषं स चतुर्विधं ।
 केचिद्वदन्ति सर्पाणां फेनं स्यादहिफेनकं ।
 यथा—धारणं श्लेष्मवर्णं च रक्तवर्णं च जारकं ।
 सारणं पीतवर्णं च कृष्णवर्णं च सारणं ।
 विषविदुषस्तं फेनं युज्यते रसकर्षणे ।

The Sanskrit word for opium, “*ahiphēna*,” lit., foam of the snake, is of modern date. It is generally held that this word has been Sanskritised from the Arabic “*aphiūn*.”

These indential distichs also occur in the commentary on *Sārngadhara* by *Adhamalla* with the additional line, षावजः (सावजः) जीरविशेषः, namely, it is the milky juice of poppy; proving that during the time of the latter its real origin was known, at the same time its supposed origin was not disbelieved.

Sārṅgadhara-saṁgraha—a compilation by *Sārṅgadhara* : its peculiarity is that it is based upon the *Āyurvedas* (*Charaka*, etc.) on the one hand and the Tantric chemical treatises on the other. In the chapter on the purification and incineration of metals, 7 of these are recognised, but strange to say there does not occur any mention of zinc. Later on, 9 metals are named including two alloys, brass and bell-metal, after the 9 planets, the significance of which will be discussed in the proper place.

The date of *Sārṅgadhara* can be ascertained with accuracy, as besides this medical compendium he is the author of the *Pad-dhati*, a voluminous miscellaney, containing, with other matters, a poetical anthology. The author dates his work in *saṁvat* 1420 or A. D. 1363. The name of the author's father is *Dāmodara* and that of the grandfather *Rāghavadeva*. The latter was highly considered by *Rājā Hammīra*, the Chauhan.*

* After the sack of Chitor by Alla-ud-din in A. D. 1303, Mewar was occupied by the garrisons of Delhi. Hammīra

There is a big commentary on this work by *Ādhamalla*, whose ancestors settled in the city founded by *Hammíra*.*

Rasendrasárasaṁgraha : The author, *Gopálakrishna*, begins by admitting that his treatise is a mere compilation based upon many Tantras, though he mentions by name only two, namely, *Rasamañjarí* and *Chandriká*. Special stress is laid on the therapeu-

recovered his ancestral throne and during his prosperous rule of sixty-four years (1301-1365) and that of his successors arts and literature found liberal patrons (*vide* Tod's "Annals of Rájastan.") The court of *Hammíra* attracted another distinguished physician named *Saugata Simha* as we gather from the colophon to a noted recipe,

एषा सौगतसिंहनामभिषजा लोके प्रकाशीकृता

हृषीकेश महीभुज * * संभोजभाजी मृशम् ।

* *Ādhamalla* gives an account of his family. His Grandfather was one *Chakrapáni*, not to be confounded with the celebrated medical author of Bengal (Vol. i, Intro. liv) and he himself was attached to the court of a ruler named, *Jaitraśimha*, whose capital *Hástikántapurí* was situated on the river *Charmanvatí*. We reproduce in the next page the text which is somewhat corrupt from the copy preserved in the Library of the Sanskrit College, Benares.

tic efficacy of mineral preparations. * Like Basendrachintámazi it assigns a minor place to the ancient Ayurvedic method of treatment by kasháyayoga, i. e., by herbs and simples; as far as the knowledge of chemical processes goes, it must be held inferior to the former. Numerous medicinal recipés

श्रीवासव्यकुलप्रकाशमणयो ये पूर्वजा विश्रुताः

श्रीहरीपुरे * * *

तदन्वये किं बहुना प्रसिद्धश्रीचक्रपाणिः कुलकौरवेयुः(शुः)

* * *

तस्य बुद्धिमुमगम्य तनूजो भावसिंह इति भूपतिमान्यः ।

* * *

तस्मात्तनूजो दीर्घमतिः प्रहृष्टो नास्मादमल्लो * * ।

तेन * * वीनाग्रये (१) (विश्रुत्यते) शाङ्गधरप्रकाशः ।

हालीकालपुरी पुरा पुरजिता काशीव विद्वज्जनै-

र्यासा यत्र सरःसरिद्वयवर्षा चर्चलती पापहा ।

यस्यां ब्रह्मवासुदेवधरचन्द्रानुजः आपतिः

स्वासी चर्चलवालि चर्चगतिषु श्रीजैचसिंहः प्रभुः ॥

तस्यां शाङ्गधरीकानां योगानां च प्रकाशिनो ।

क्रियते सादमज्ञेन संहितायाः प्रदीपिका ॥

* For a description of some of these vide "Journal des Savants," April 1898.

agree word for word with those in *Rasendra-chintámani*, which only proves that both have drawn on a common stock. There is no question of the one borrowing from the other, as internal evidence proves that both belong to the same period. Abhayánanda Gupta in the preface to his edition says :—"There is a tradition to the effect that Gopála Kavibhúshana of Dakshina Bāṅga is the compiler of this book ; but this can scarcely be accepted as he lived not long ago." Again. "Its commentator, Rámasena Kavíndramani (author of *Arthabodhiká*) was court physician to Nawáb Jaffer Ali Khan of Bengal (Mir Jaffer) some 200 years ago." Rámasena himself quotes from 3 commentaries of this book ; hence it was recognised as of some degree of importance at that time and must have been composed long before. This work is very popular in Bengal and is a *vade mecum* of the local Kavirájas.

Rasendrakalpadruma is another work of this period. It deals chiefly with mineral preparations and is a mere compilation from

Rasárnava, Rasamaṅgala, Ratnākara, Rasāmrīta and Rasaratnasamuchchaya ; the numerous citations with which it is replete are of some use in correcting many doubtful readings in these latter. Our MS. is incomplete, the first few couplets and the sequel being lost ; for the opening lines of the work see Aufrecht's Catalogue of the Bodleian Library, MSS., pt. I., p. 321.

Dhāturatnamālā : This epitome is devoted exclusively to short processes of *killing* metals and minerals. Six metals are recognised at the outset, namely, gold, silver, copper, lead, tin and iron as in the ancient works; but strange to say later on *kharpara*, * which is the mineral calamine, is taken as synonymous with *jasada* or zinc. We have before us a MS. procured from Benares. It is full of corrupt readings. The copy noticed in the Bodleian Library Catalogue seems to be more correct. From the colophon in the latter we learn that the author is one Devadatta of Gujarāta, but in the Benares exemplar

* Vol. i, p. 158,

this portion has been coolly tampered with, so that this poor compilation may be palmed off as an integral part of a *Samhitá* of the *Asviníkumáras*, the divine physicians, and thus entitled to the respect due to revelation. This work cannot be placed earlier than in the 14th century. Here we have a serious sidelight into the history of literary forgeries.

noteworthy circumstance in connection with this is that the Bhāvaprakāsa, which is posterior to Rasapradīpa, is silent about sam-khadrāvaka, which had come to be prescribed by this time as a favorite remedy for indigestion and derangement of liver and spleen; the solvents being borax, treacle, etc.—(cf. vol. i, p. 130). In the Bhāvaprakāsa among the acids we have only the juices of acid fruits. This is only another instance of the danger one is liable to incur by drawing inferences from *argumentum ex silentio*.

Rasakaumudī is another compilation belonging to this period and as far as its contents go it is comparable to Rasapradīpa in many respects; both opium and mineral acids are prescribed. From the colophon in the Calcutta Sanskrit College Library MS. we gather that the author is a physician named Mādhava. Curiously enough he is often confounded with the celebrated Mādhavakara, the author of the Nidānasaṃgraha, who preceded the former by some 8 or 9 hundred years.

The next work which should now claim our attention is the well known *Bhāvaprakāśa* of *Bhāvamisra*. It is a voluminous compilation in which the Ayurvedic method of treatment has been mainly adopted and as such ample citations are given from the *Charaka*, *Susruta*, *Vāgbhata*, *Hārīta*, *Vrinda* and *Chakrapāni*. But the Tantric remedies could not altogether be given a wide berth and accordingly one or two chapters have been devoted to mineral preparations ; but these have been borrowed chiefly from *Rasapradīpa*, *Rasendrachintāmani*, *Sūringadhara* and other standard works. *Bhāvamisra* has been scrupulously candid in his acknowledgments to the various authorities quoted by him. *Phirangaroga* is mentioned as also its treatment with the help of calomel and *chobchini*. The author lived about the time of the Emperor Akbar and evidently in that part of India which is now known as the United Provinces and it is not to be wondered at that Mussulman influence is discernible in his book.

We conclude our survey of this period with the notice of a remarkable production

entitled Dhátukriya or “operations with metals”; it is in the shape of a dialogue between Siva and Párvatí; in short, it pretends to be a part and parcel of the Rudrayámala Tantra.* The work cannot be placed earlier than in the 16th century A. D., as it contains reference to the country of the *Phirangas* and to Rúma, the Arabic name for Constantinople. For the first time we come across the very appropriate term *dáhajala* (lit. burning water) coined to denote sulphuric acid. The information about the metals is of a very meagre and poor description and it has been needlessly spun into an inordinate length. The author evidently considers it a pious fraud to make such statements as follow emanate from the mouth of Siva himself:—

“By using coins made of imitation gold one can carry on exchange . . . and thus enrich oneself.”

* We have in hand transcripts of two MSS.—one from the Library of the Maharájá of Ulwar; the other named somewhat differently, Dhátumñjarí, from Benares. They agree very closely.

The curious reader who is referred to the translations of the selected portions of the text given elsewhere will not fail to recollect similar passages in the Leyden Parchment where the dishonest goldsmith gives numerous recipes for "augmenting gold." * Fraudulent attempts in the direction of palming off alloys of base metals, possessing bright, yellow lustre, for gold, have been made in all ages and in all climes (*cf.* extracts from *Rasárnava*, Vol. i, p. 74).

Arkaprakāsa or a treatise on the preparation of medicinal tinctures and essences should also find a place here ; † its authorship is ascribed to Rāvana, the mythical king of Ceylon. The contents of the work, however, reveal its date. For instance, mercury, treated with *Samkhadrāvaka*, is prescribed as the remedy for "Phiraṅgaroga" (syphilis).

* Berthelot : "Collection des Alchimistes grecs" (trad. p. 287), "La Chimie au Moyen Âge," t. i, p. 31.

† There is a Calcutta edition published by Gaṇeśa Chandra Ghoshā ; we have compared it with a MS. procured from the Sanskrit College, Benares. They agree remarkably well.

Opium also is prescribed ; while the term yasada is used to indicate zinc. As a distilling apparatus a tinned copper vessel is recommended. Mahommedan influence is distinctly discernible in this hybrid production. The very title of the book is no doubt Sanskritised from the Persian *arrak* (essence).

It is unnecessary to proceed further. We have before us the MSS. of Rasamañjarí by Sálinátha, of Rasarañjana, of Gandhaka-kalpa (a Tantra), of Rasárnava (quite distinct from the standard work bearing the same title,) of Basaratnákara (altogether different from that of Nityanátha) and several others. As all of these repeat *ad nauseam* the processes already described, we refrain from examining their contents here.

CHAPTER V.

INDIGENOUS ORIGIN OF INDIAN ALCHEMY.

The reader who has been able to follow us throughout with patience will not have been slow to recognise that alchemy in India has been developed all along on independent lines. Its origin and growth are interwoven with a phase of religious activity—the outcome of purely indigenous traits—which has been discussed at length in chapter i.

The only instance in which we find some allusion to adepts outside the pale of Hindu institutions occurs in *Rasaratnasamuchchaya*.* But the term *Mlechchha* used there is a generic one applied indiscriminately to the

* *सौख्यसाधकान्*. *Vide* Vol. i, Sans. texts, p. 56; a variant in the Poona edition has *मेलकसाधकान्*, which must be rejected as both the Benares and Kásmír MSS. accept the former.

Sakas, the Yavanas (Greeks or Bactrians), the Chínas (Chinese), etc. The Hindus have never been shy of acknowledging their obligations to the Yavanas; Varáhamihira for instance expresses his admiration for the proficiency of the latter in the field of astronomy and would gladly learn at their feet.* In the Mahábhárata again we find the services of the Yavana architect, Purochana, requisitioned. We have not, however, come across a single passage, which may be construed into implying a hint to alchemists in the West. That the term Mlechchha in B. B. S. really refers to the Kirátas is evident from the colophon to Basahridaya. †

Those scholars who have hitherto maintained that Indian alchemy is of exotic origin, have, we are afraid, done so on *a priori*

* खेच्छा हि यवनालोषु सम्पत्तं ब्राह्मणितं स्थितं ।

अथिवशोऽपि पूज्यन्ते किं पुनर्देवविद्वजः ॥

† Sans. texts, p. 39; there the four castes (चतुर्वर्णं) are distinctly mentioned and the kirátas evidently included under the Mlechchhas.

grounds. Indeed the frame of mind which they have brought to bear upon this subject is not calculated to lead to a judicial and dispassionate verdict. The fact that the Hindus are indebted to the Greeks for substantial improvements in their astronomy is too often urged whenever it is necessary to support such a view. * There is, however, very little affinity in the mode of growth of alchemy in India and of its *congener* in the West. The progress of magic, witchcraft and alchemy can be traced from the Atharva-

* Cf.—“ It was, however, Greek influence that first infused a real life into Indian astronomy. This occupies a much more important position in relation to it than has hitherto been supposed ; and the fact that this is so, *eo ipso* implies that Greek influence affected other branches of literature as well, even though we may be unable at present directly to trace it elsewhere.” Weber: Hist. Sans. Lit. ed. 1892, p. 251. In justice to Weber, however, we should quote here his views on the independent origin of Hindu medicine ; namely, “ the weights and measures to be used by the physician are expressly enjoined to be either those employed in Magadha or those current in Kalinga ; whence we may fairly presume that it was in those eastern provinces, which never come into close contact with the Greeks, that medicine received its special cultivation.”—p. 269.

vedas onwards to the later Tantras according to the laws of evolution without any breach of continuity.

One of the most favourite doctrines of the neo-Platonists was that the metals were engendered in the womb of the earth under the influence of the planets. According to Olympiodorus (5th century A. D.) lead is begotten by Saturn, "electrum" * by Jupiter, iron by Mars, copper by Venus, tin by Hermes, gold by the Sun and silver by the Moon. † Now, such a fascinating astrological belief was pre-eminently calculated to appeal to the Hindu instinct, especially as there was a "commercial and lively intellectual intercourse," to quote Weber's own words, between Alexandria and the West Coast of India. Varāhamihira's *Vṛihatsam-*

* An alloy of gold and silver was known by this name. Later on it disappeared from the list of metals, tin being assigned to Jupiter, and mercury to Hermes.

† The influence of the astral bodies on the production of the metals can be traced to Proclus' commentary on the *Timæus*.—Berthelot: "*Les origines de l'Alchimie*:" p. 49; also *Coll. des. Alch. Grecs.* trad. p. 100.

hitá, if anything, is a repertory of astrological notions. In vain do we look even there for any such chance and solitary reference.* The alchemical literature of India is equally silent about it. † True it is there are two metals which are often designated as the sun and the moon respectively, namely copper

* Chapter.xvi of this work treats of "countries, people and things belonging to the domain of each planet." Among sundry other things "the Sun is the lord of gold and fire." Thousand and one articles are said to be presided over by the Moon, Mars, Mercury, Jupiter, Saturn, Venus, Ráhu and Ketu ; but nowhere is there any connection between the planets and the metals. *Vide* Kern's trans., pp. 97—101.

† The mythical origin of some metals is given in the *Purá-nas* ; but no reference to the astral bodies is to be found. Thus silver originated from the tears of the God Siva, copper from the semen of the God Kártikeya, lead from the semen of the Snake God Vásuki, iron from the different parts of the body of the demons called Lomilas ; and gold from the semen of the God of fire. Some vague and remote connection only can be established between this sort of nomenclature and that of the old Greco-Egyptian alchemists. According to the latter mercury is sometimes designated as the semen of Hermes ; whilst in the Tantras it is the semen of Siva (हरबोज). *Vide* "Intro. a l'élude de la chimie des anciens," p. 11.

and silver.* But this has nothing to do with the planetary generation of these metals. In the imagery of the Sanskrit poet the crimson tint of the rising sun and the pale white lustre of the moon are comparable to the colour of copper and silver respectively.

The old Greek writers repeatedly refer to the mystic relationship between the seven planets and the seven metals. In the Sanskrit literature, however, beginning with the Susruta and coming onwards to Basaratna-samuchchaya, we invariably find six metals recognised, alloys being rigorously excluded from the list and regarded simply as "artificially made."† It is only in the Sārṅga-dhara and other later works that we find seven metals enumerated;‡ but this author

* रवि, चक्र and other synonyms are, as a rule applied to copper but rarely to gold.

† *Vide* Vol. i, pp. 48, 72 and 127.

‡ (आर) brass being taken as the additional metal; zinc was evidently unknown to Sārṅga-dhara.

सर्वद्वारागतास्त्राणि नामवल्ली च तीक्ष्णकम् ।

आवयः सप्त विज्ञेयाः ।

is guilty of a curious inconsistency, since in a subsequent part of his book he adds two more to the list and quietly lays down that there are nine metals, *which derive their names from the nine planets.* * This may be read as a sort of vague and indistinct connection between the metals and the astral bodies.

The Arabs who adopted many of the Greek doctrines of alchemy also represented the seven metals by the seven planets. In fact it was through the medium of the Arabs

* "Kámsya" (bell-metal) and "Vrittaloḥa" or "Var-taloḥa" (cf.—Vol. i, p. 114) make up the number. Ráhu and Ketu are the two mythical planets; they are in reality the ascending and descending nodes in the ecliptic. Ráhu is supposed to cause the eclipse of the sun and the moon by swallowing it up.

Sáṁgadhara stops here, but his prolix commentator, Adha-malla supplies the deficiency by making copper stand for the Sun, silver for the Moon, brass for Mars, iron for Saturn, gold for Jupiter, tin for Venus, lead for Mercury and bell-metal and vartaloha for Ráhu and Ketu respectively.

It will also be noticed that lead is here represented by Mercury; but in the Hindu alchemy mercury always stands as the visible manifestation of the God Śiva, it being generated from his semen, hence the name इरवीज given to it.

and the Jews that a knowledge of the Greek sciences including alchemy filtered to the European nations during the middle ages.* We have already seen that Rájputána had been overrun and even occupied for a brief period by the Mussulman conquerors shortly before the time of Sárṅgadhara and it is reasonable to suppose that he had gleaned some astrological notions from that quarter.

We now advert for a moment to the main question of the connection of the comparatively modern and scientific phase of Hindu astronomy with the science of Alexandria. Although it is admitted by all those who are entitled to speak with authority on the subject that the Hindus borrowed from the Greeks and thus improved upon their older system, many points have yet to be cleared up. Professor Whitney who has

* "C'est par l'intermédiaire des écrits arabes et hébreux que la plupart des connaissances scientifiques des Grecs en mathématiques, en astronomie, en physique et en médecine, ont été transmises au moyen âge occidental ; les écrits Grecs proprement dits n'ayant guère été connus directement avant la Renaissance."—"La Chimie au Moyen Âge," T. i, p. 229.

carefully studied the subject is struck with the circumstance that the Sūryya and other Siddhāntas bear resemblance to the system of Hipparchus rather than that in the Syntaxis.* In other words the transmittance of astronomical knowledge must have taken place before the time of Ptolemy. Now the period of lively intercourse is precisely that covered by the age of Ptolemy and that of his followers, and yet the Indian astronomers seem to be unaware of his teachings.†

* Intro. to "Sūryyasiddhānta". We find from Ptolemy that the observations of Hipparchus extended from B. C. 162 to B. C. 127. Ptolemy flourished at Alexandria in the second century A. D., under the reigns of Adrian and Marcus Aurelius.

This was also pointed out long ago by Colebrooke, *e. g.* "The whole cluster of astronomers mentioned by Brahma Gupta must be placed in the interval between the age of Hipparchus, and possibly that of Ptolemy."—*Essays*, pp. 411—412.

† Aryabhatta composed his treatise "Laghvāryabhattīyam," in 496 A. D., and Varāhamihira his "Pañchasiddhāntikā" about 550 A. D. But these astronomers borrowed from the much older treatise entitled "Romakasiddhānta" ascribed to Śrīsenā, and Paulīśasiddhānta (*vide* Thibaut's Intro. to Pañchasiddhāntikā, xxvii—xxxvi).

This mystery has never been elucidated; Dr. Thibaut's arguments are ingenious, but, we are afraid, by no means convincing.* Indeed in the purely mathematical sciences the Hindus far excelled the Greeks of the Alexandrian school. Aryabhata's knowledge of algebra was superior to that of Diophantus and as for arithmetic it is generally acknowledged to be of Indian origin.†

The last word on the subject has yet to be said and it is doubtful if this dark recess will ever be illumined. In the meantime it would be better to hold our judgment in abeyance. At best we can only launch into hypotheses

* L. c., pp. li and liii.

† Cf.—Colebrooke: "Admitting the Hindu and Alexandrian authors to be nearly equally ancient, it must be conceded in favour of the Indian algebraist, that he was more advanced in the same."—*Essays*, iii, 429. Again, "in the whole science he [Diophantus] is very far behind the Hindu writers," *ibid*, p. 438.

Kaye has recently questioned the priority of the claims of the Hindus: *Vide* J. A. S. B. iii [N. S.], July, 1907.

or indulge in dogmatic assertions.*

* One who approaches this subject should divest himself of prepossessions or the "bias of patriotism" as Herbert Spencer puts it. A very agreeable feature in this controversy is that those who are most competent to speak with authority are extremely modest, nay diffident in giving expression to their views. Woepcke in his masterly memoir "on the propagation of the Indian numerical symbols" says:—"La solution parfaite de ces problèmes ne résulterait que d'une connaissance tellement complète des événements et de leurs phases, qu'il faut à peu près renoncer à jamais l'obtenir. D'un autre côté, remplir les vides par des hypothèses arbitraires ou preconçues serait livrer l'histoire des sciences aux hasards et au dogmatisme des inspirations individuelles." "Journal Asiatique" (1863).

Lassen whose modesty is only equalled by his profound scholarship observes:—"Es wäre sehr wünschenswerth, daß ein mit der gehörigen Kenntnifs der Sanskritsprache ausgerüsteter Kenner der Mathematik und Astronomie es unternähme, aus diesen vorhandenen Hülfsmitteln die Lücken unserer Kenntnifs auf diesem Gebiet des Indischen Alterthums auszufüllen; für jetzt müssen wir uns darauf beschränken, die hauptsächlichsten Ergebnisse der bisherigen Untersuchungen zusammenzustellen." "Indische Alterthumskunde." Vol. ii. p. 1150; ed. 1874.

CHAPTER VI.

SOME NOTED INDIAN ALCHEMISTS AND THEIR WORKS.

Aufrecht in his notice of the MS. of *Rasaratnasamuchchaya*, * evidently from a mistaken notion that the pursuit of chemistry was unknown in ancient India, goes somewhat out of his way in asserting that the names of the 27 alchemists, mentioned in the beginning of that work, † are mostly apocryphal. We have, however, positive proofs that these personages far from being evolved out of the imagination of the author existed in real flesh and blood and contributed not a little to the progress of chemical science. Thus we read in *Rasaratnākara* of "chemical operations performed by *Māṇḍavya* " and also find *Ratnaghosha* taking part in a dialogue on certain processes, ‡ *Yasodhara*, again, is the author of the comprehensive work named *Rasaprakāśasudhākara*

* *Catalogus Catalogorum*, ii, p. 116.

† *Vide* Vol. i, p. 77.

‡ Eng. trans. pp. 6—8.

which we have noticed at some length in the present volume. Vyádi is a prominent name both as a grammarian as well as a chemist. The *Garuḍapurāṇa* quotes him as an authority on gems.* Nandí, as we have already seen, is distinctly referred to by Somadeva as the inventor of the *koṣṭhī* apparatus and of the process of sublimation. †

There are, indeed, a great many names scattered throughout the mass of chemical and medical literature, some of which have been handed down to posterity, sometimes on account of the important processes they invented and sometimes, again, because of the efficacy of the metallic preparations which they introduced. Thus in *Rasendra-chintāmaṇi* we come across the name of Siddha Lakshmīśvara. The names of the sage Brahmajyoti, Manthānabhairava, Svachchhandabhairava and Gahanānandanātha have in this manner been rescued from oblivion. Most of these were Buddhist monks.

* व्याडिर्जगद् जगतां हि महाप्रभावः सिद्धी विदग्धहिततत्परया दयाशुः ।

† Intro., lv.

Sivadāsa in his commentary on Chakrapāṇi quotes besides Patañjali, Bhavyadattadeva as an expert on iron preparations. We give below the names of some of the authors and their works over and above those already noticed. It is scarcely possible to submit an exhaustive list.

Name of the Author.	Name of the work.
Anandānubhava	Rasadīpikā.
Balabhadra	(Unknown).
Bhojadeva	Rasarājamṛigāṅka.
Chandrasena	Rasachandrodaya.
Charpata	Charpatasiddhānta.
Dhanapati	Divyarasendrasāra.
Garuḍadattasiddha	Rasaratnāvalī.
Gorakshanātha	Gorakshasamhitā.
(Unknown.)	Bauddhasarvasva.
(Unknown.)	Rasesvarasiddhānta.
Harihara	Rasavisvadarpana.
Kaṅkāli	Rasakaṅkāli.
Kapāli	Rasarājamahodadhi.
Keśavadeva	Yogaratnākara.
Mallāri	Rasakautuka.
Narahari	Rasayogamuktāvalī.
Rāmarāja	Rasaratnapradīpa.
(Siddha) Bhāskara	Rasendrabhāskara.
(Siddha) Prāṇanātha	Rasadīpa.
Srinātha	Rasaratna.
Trimallabhatta	Rasadarpana.
Vaidyārāja	Rasakashāyavaidyaka.
Vandimisra	Yogasudhānidhi.
Vāsudeva	Rasasarvesvara.

The Tantric Period

(Continued).

Chemistry In Rasaratnakara of Nagarjuna.

[In the rendering of Rasaratnākara of Nāgārjuna and other Sanskrit texts we have often given only free translations. Such passages as are unnecessary repetitions or are not of sufficient interest to the general student of the history of Chemistry have been left out]

CHAPTER I.

I shall now speak of the purification of the important rasas* (minerals).

What wonder is it that rājāvarta digested with the juice of *Acacia sirisa* converts silver of the weight of one guñja into one hundred times its weight of gold of the lustre of the rising sun ? 1

* Regarding rasas see Vol. 1, p. 79.

HINDU CHEMISTRY

What wonder is it that yellow sulphur, purified with the juice of *Butea frondosa*, converts silver into gold when roasted thrice over the fire of cowdung cakes ? 2

What wonder is it that calamine roasted thrice with copper converts the latter into gold ? * 3

* These laconic recipes all refer to the floating mass of traditions current at the time of the author on the transmutation of the base metals into gold. As they are of a fragmentary and disjointed character, the meaning is not always clear. Recipe 3 also occurs in *Rasārṇava*; *vide* Vol. i, pp. 70-71. Various ingenious methods were resorted to for debasing gold or making an alloy, which would mimic the appearance of this metal. Silver, copper, lead, zinc and mercury were often made into an amalgam, and the latter rendered compact and coloured yellow with the aid of orpiment. No wonder that the law-books prescribe several penalties on the fraudulent debasers of the precious metals. Thus according to Manu "the king shall cause a goldsmith, who behaves dishonestly, the most noxious of all the thorns, to be cut to pieces with razors." IX, 292.

The reader who feels interest in this subject may consult Berthelot's, "La Chimie au moyen âge," t. i. pp. 31 *et seq.*, where will be found several recipes for augmenting gold *aurum plurimum facere*, or for the "fabrication of gold." One example may be cited here. Take gold, copper and mercury, make an amalgam of the whole, afterwards add sulphur, orpiment, "sandarac" (a kind of resin) and the bile of the vulture &c. The author of the recipe thus concludes:—"Thou wilt now discover a secret, which is sacred and worthy of praise" (l. c. p. 35).

HINDU CHEMISTRY

What wonder is it that cinnabar digested several times with the milk of the ewe and the acids* imparts to silver the lustre of gold glowing as saffron ? 4

Digestion [of minerals] is to be effected in the decoction of *Dolichos uniflorus*, *Paspalum scrobiculatum*, the urine of man and the acid juices of [the fruit of] ratan (*Calamus rotang*) and afterwards with the addition of the alkalis (soda, borax &c.) The operation of roasting is to be performed thrice.—Cf. the process of Rasaratnasamuchchaya (R. R. S.), Bk. ii, 67-68 in Vol. i, p. 83.

What wonder is it that the pyrites macerated in the juice of *Musa sapientum* and in castor oil and clarified butter, and placed inside the bulb of *Arum campanulatum* and roasted [in a closed crucible] undergoes perfect purification ? † 6

Chapala and other minerals, being macerated in the juice of the lemon for 3 days, become purified. Gold being smeared with the 5 earths, the ashes and salts ‡ and roasted, undergoes purification. 12

* Vegetable acids are meant here. *Vide* Vol. i, p. 128.

† Here extraction of copper from the pyrites is no doubt meant. Cf. R. R. S. Bk. ii, 89-90; *vide* Vol. ., p. 84.

‡ Cf. R. R. S. Bk. x, 71, 85; *vide* Vol. i, pp. 128-129.

Silver alloyed with lead and fused with ashes becomes purified.* 13

Lo! it is not to be wondered at that copper, melted with the alkali derived from the earth† and the milk of the ewe, clarified butter and one-sixteenth of its weight of oil, will become pure like the crescent of the moon. 14

Verses 23-25: Extraction of the essence of *vaikrānta*: exactly the same as in R. R. S. Bk. ii, 71-72. *Vide* Vol. i, pp. 83-84.

Verses 25-30: Have reference to the extraction of copper from *mākshika* and *tāpya* (varieties of the pyrites). They agree in all essentials with *Rasārṇava*, Ch. VII, 12-13. *Vide* Vol. i, p. 70.

Verses 31-32: Extraction of zinc from calamine. Cf. R. R. S. Bk. ii, 163-164. *Vide* Vol. i, p. 88.

Verses 35-36: Exactly the same as in R. R. S. Bk. ii, 103-104. *Vide* Vol. i, p. 85.

* Verse 37: Essence of *darada*, *i. e.* extraction of mercury from cinnabar by distillation. Cf. R. R. S. Bk. i, 89-90. *Vide* Vol. i, p. 78.

* Refers to cupellation. Cf. *Rasārṇava* in Vol. i, p. 68, footnote (1).

† *वृषिकीमणि* *चारिण* may refer to natron or to saltpetre.

HINDU CHEMISTRY

Verses 50-51 : Dissolution of gems (pearls &c.) by digestion in vegetable acids, *e. g.* sour gruel (impure vinegar) and the juice of certain acid plants.

* * * *

Here ends Chapter Second of Rasaratnākara by Nāgārjuna on the *killing* of diamond and the metals, extraction of the essence of minerals and liquefaction of mica.

CHAPTER III.

I shall now explain [the process of] fixation of mercury. The king of rasas (mercury), rubbed with the juice of lime, sal-ammoniac, the acids, the alkalies, the 5 salts, *Piper nigrum*, *P. longum*, the dried root of ginger, the juice of *Moringa pter.*, the tuber of *Amorphophallus campanulatus*, can readily amalgamate itself with the 8 metals.

* * * *

Prajñāpāramitā (perfection of wisdom) appeared before Nāgārjuna at midnight in a dream and revealed to him the ingredients of a recipe (consisting of steel, copper, mica, pyrites, &c.) 4

Mercury is to be rubbed with its equal weight of gold and then [the amalgam] further admixed with

sulphur, borax &c. The mixture is then to be transferred to a crucible and its lid put on and then submitted to gentle roasting. By partaking of this elixir (*i e.* the sublimate) the devotee acquires a body not liable to decay. 30-32

I shall now describe the Garbha yantram.*
62-65

Recipe for Kajjali or æthiops mineral. † 84-86

* * *

Having made salutation to all the Buddhas, free from the taint of sins, I shall now deliver the Kakshapuṣa tantram ‡ for the benefit of suffering humanity.

[The most important part, from an historical point of view, is the dialogue between Nāgārjuna, King Sālivāhana and Ratnaghosha. |

Nāgārjuna, whose end (salvation) had been attained, benevolent towards all living creatures, blessed with all favours, residing on mount Śrīśaila, before him stood Ratnaghosha with folded arms,

* The same as in Rasārṇava. Vide Vol. i, p. 66.

† The process is practically the same as in Chakrapāṇi; vide Vol. i, p. 58.

‡ There is extant a Tantra, which goes by this name, the reputed author of which is Nāgārjuna.

saying: "Be pleased to communicate to me knowledge on chemical operations."

Nāgārjuna said :—

Well done ! well done ! I am pleased with your devotion and shall convey to you all that you want to know, namely remedies for warding off wrinkles, grey hair and other signs of old age. Mineral preparations act with equal efficacy on the metals as on the body (human system). *

* * * *

For the benefit of living beings I went through all manner of penances for 12 tedious years and worshipped the goddess Yakshinī presiding over the *Ficus religiosa*. Then I heard an oracle.

Nāgārjuna said:—

O Goddess ! if thou art propitiated, be pleased to communicate to me the rare knowledge* of the fixation of mercury.

* * * *

Sālivāhana said :—

I have dedicated to thee, O Goddess ! treasures of gold and gems, now I await thy instructions.

* This was a favourite metaphor with the alchemists. Cf. Vol. i, Intro. lxxvi.

The Goddess said :—

Well done ! well done ! O wise ruler ! I shall speak to you of chemical operations performed by Māṇḍavya.* ... A disciple should be intelligent, devoted to work, sinless, and master of his passions.†

The apparatus known as *koshṭhi*, mouth blow-pipe, cow-dung, substantial wood (as fuel), a pair of bellows, iron plates, * * * having collected all these, chemical operations are to be performed.‡

* * * *

Ratnaghosha said :—

Having prepared with great care "the powder of projection," which transforms a ten million times its weight of the base metal into gold, § * * *

Nāgārjuna said :—

I shall convey to you what has been experimented upon by Sākūṇḍa. ¶

* * * *

* A well-known alchemist; one of the 27 adepts mentioned in the opening lines of R. R. S. *Vide* Vol. i, p. 77.

† Cf. "Initiation into discipleship" in Vol. i, p. 115.

‡ Cf. *Rasārṇava* in Vol. i, pp. 64-65.

§ कौटिल्यो महारथः—the term कौटिल्यः has technical meaning. Cf. Vol. i, p. 120.

¶ We are unfamiliar with this name, probably the reading is corrupt.

HINDU CHEMISTRY

~~~~~  
Tests for *killed* mercury.

The first two couplets are almost the same as in *Rasārṇava*. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (*i. e.* is not readily volatilised), then it is to be regarded as *fixed*.

Here follows a list of apparatus borrowed from *Rasendramāṅgala*.—Detailed account of most of these will be found in R. R. S. Bk. ix. *Vide* Vol. i, p. 67.

### **Chemistry in Rasahrīdaya of Bhikshu Govinda.**

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 \* \* \*

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 68. *Vide* Vol. i, p. 121.

The Goddess said :—

Well done ! well done ! O wise ruler ! I shall speak to you of chemical operations performed by Māṇḍavya.\* ... ... A disciple should be intelligent, devoted to work, sinless, and master of his passions. †

The apparatus known as *koshthi*, mouth blow-pipe, cow-dung, substantial wood (as fuel), a pair of bellows, iron plates, \* \* \* having collected all these, chemical operations are to be performed. ‡

\* \* \* \* \*

Ratnaghosha said :—

Having prepared with great care “the powder of projection,” which transforms a ten million times its weight of the base metal into gold, § \* \* \*

Nāgārjuna said :—

I shall convey to you what has been experimented upon by Sākāṇḍa. ¶

\* A well-known alchemist; one of the 27 adepts mentioned in the opening lines of R. R. S. *Vide* Vol. i, p. 77.

† Cf. “Initiation into discipleship” in Vol. i, p. 115.

‡ Cf. *Rasārṇava* in Vol. i, pp. 64-65.

§ कोटिबैद्यो महारसः—the term वैद्यः has technical meaning. Cf. Vol. i, p. 120.

¶ We are unfamiliar with this name, probably the reading is corrupt.

### Tests for *killed* mercury.

The first two couplets are almost the same as in *Rasārṇava*. Cf. Vol. i, p. 74.

When the quicksilver, which has acquired the colour and the lustre of the rising sun, stands the test of fire (*i. e.* is not readily volatilised), then it is to be regarded as *fixed*.

Here follows a list of apparatus borrowed from *Rasendramāṅgala*.—Detailed account of most of these will be found in R. R. S. Bk. ix. *Vide* Vol. i, p. 67.

## Chemistry in *Rasahridaya* of Bhikshu Govinda.

Quicksilver digested with sour gruel and then subjected to distillation is freed from [the impurities of] lead and tin. 1

Much the same as above. 2 \* \* \* \*

Description of the apparatus for purification of mercury by sublimation and distillation: it agrees almost literally with that given in R. R. S. Bk. ix, 68. *Vide* Vol. i, p. 121.

## Patala vii.

Ingredients for making a *vida* for killing metals. Cf. *Rasārṇava*, IX, 2-3. *Vide* Vol. i, p. 72.

Preparation of mild alkali from the ashes of plants:—

The process must be considered as a poor one, compared to the elaborate description in *Susruta*. Cf. Vol. i, p. 32.

## Patala viii.

\* \* \* Alum, blue vitriol:—all these severally or collectively are favourable for imparting colour to quicksilver. \*

Experts [on the properties] of metals are of opinion that tin gives strength, *tīkshṇa* colour, lead unctuousness, copper all these qualities [to mercury.]

Couplets (in p. 29, Sans. texts): The purport seems to be that when mercury is rubbed with certain sulphides, *e. g.* orpiment, pyrites &c., and sub-

\* The text is not very intelligible. The other ingredients mentioned are *tīkshṇa* and *kanta*, these being varieties of iron; but iron will not amalgamate with mercury. *Tīkshṇa* may also mean a kind of saline earth. The old alchemists racked their brains in devising ingenious processes for robbing mercury of its fluidity and imparting to it various colours. Cf. *Rasārṇava*, IX, 2-3, XI, 197-198. *Vide* Vol. i, p. 74 and also "The Hindu method of manufacturing calomel."—*Ibid.* p. 250.

limed, it assumes the colour of lac or *Coccinella* insect (a poetical and figurative way of expression for red colour) in the shape of the red crystalline sulphide.

#### Patala ix.

Vaikrānta, kānta, sasyaka, mākshika, vimala, adri, darada, rasaka:—these are the 8 rasas\* and their essences are well suited for chemical operations.

Sulphur, gairika, kshiti, khechara (mica), añjana, kañkushtha:—these are the uparasas. Cf. Vol. i, p. 89.

Gold and silver are the *noble* metals.

Copper, brass, tikshṇā and kānta (varieties of iron) are the essential or substantial metals; lead and tin emit foetid odours. Cf. Vol. i, p. 113, footnote (1).

The six salts are:—Sauvarchala, saindhava, chūlika (sal-ammoniac), sāmudra, romaka and vida. The alkalies are:—Sarjikākshāra, yavakshūra and borax. (*Vide* Vol. i, Index of subjects.)

#### Patala xi.

A cupel made of boneash (goat's) and lined internally with borax &c.

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\* Cf. Vol. i, pp. 79-81.

Colophon giving an account of the author :—

Madanaratha, King of Kirāta, teacher of mercurial lore, in whom the Goddess of the science of mercury and minerals (Chemistry), the source of all good, has taken her abode for the benefit of mankind, who can restore to the disfigured patient, afflicted with leprosy, the healthy comeliness and lustre of youth :

Bhikshu Govinda, well versed in chemical operations and loaded with honours by the King of Kirāta, composed this tantra entitled "Rasahridaya."

This tantra is written by Govinda, the grandson of Maṅgalavishṇu and son of Sumanovishṇu :—  
May Tathāgata pronounce his blessings.

## **Chemistry in Kakachandesvari- mata Tantra.**

*Pātala i.*

The first *pātala* gives the origin (mythical) of the tantra.

*Pātala ii.*

Kakachandesvari said :—

\* \* \* Please, give a brief account of the

Chemistry of the metals, the killing of mercury and minerals and the fusion of the gems. 3 4

Sri Bhairava said :—

\* \* \* Mercury rubbed with the ingredients of the *vida* (see Vol. i, p. 72) and roasted in a closed crucible, is killed instantly. That mercury now acquires the power of converting a base metal into 1,000 times its weight of gold. 13-16

Copper, treated with the above preparation of mercury and rubbed with the acids, alkalies and the milky juice of *Calotropis gig.*, and roasted in a crucible, turns into gold. 18-20

Earth for making crucibles. 21-22 Cf. Vol. i, pp. 67-68.

Transmutation of iron into gold :—process not clear. 25-32

### Patāla iii.

Liquefaction of mica :—

Thin plates of mica are to be smeared with the 3 alkalies and borax and strongly heated in a crucible. The whole mass fuses.\* \* \* \* 29 30

\* Refractory silicates are treated similarly at the present day with the "fusion mixture".

## Chemistry in Rasendrachudamani of Somadeva.

*Sans. texts, p. 51.*

Tests for killed iron (rouge).

As R. R. S. has borrowed these from the present work, it is unnecessary to repeat them here. *Vide* Vol. i, pp. 118-119.

*Sans. texts, pp. 52-53.*

Take lead of the weight of 30 palas and rub it with the milky juice of *Calotropis gig.* and calcine it till its weight is reduced to a karsha : this residue, even if it be calcined a thousand times, will not undergo further decay (*i.e.* diminution in weight). Metallurgists call this residue derived from lead Chapala.\*

Tin also similarly treated will yield a chapala, which, on merely being touched with the hand, kills (fixes) mercury. This mercury is recommended for metallurgical and not for chemical purposes.

\* Possibly it refers to lead derived from *argentiferous galena*. The lead, being cupelled off in the shape of litharge, will leave a button of silver, which will not undergo oxidation.

*Sans. texts, pp. 53-54.*

[A somewhat complex process described, which is not very clear. We shall try to give the purport thereof. The quantitative measurements are of particular interest.]

1 pala of tin should be taken and rubbed with 10 nishkas of mercury and made into a cake with the addition of zinc; \* it is then to be digested with the decoction of certain herbs and plants and warm vinegar and once more rubbed with  $\frac{1}{2}$  pala of blue vitriol † and the juice of *Abrus precatorius*. The mass is then to be divided into small pills; these should then be put into a crucible with the lid on and the fire to be urged by means of bellows. The essence is then to be taken out of the crucible. This essence of the weight of 10 Sānas is then to be enclosed in a mixture of ashes and salts and roasted. This essence of the weight of 2 nishkas is then to be fused with 80 times its weight of lead. \* \* \*. This (essence) is also termed chapala. Cf. "the gold-like alloy" in Vol. i, pp. 74-75.

\* रसकस्य सुक्षेन.

† पलाईयुद्ध सस्येन.

*Sans. texts, p. 55.*

When quicksilver has been deprived of its physical properties (lustre, fluidity &c.) it is known as *nashṭāpishṭa*. Cf. Vol. i, p. 74.

Somadeva will now give a brief account of the apparatuses, after having consulted numerous chemical tantras. (Here follows the description, which has been reproduced *verbatim* in R. R. S. *Vide* Vol. i, pp. 121 *et seq.*)

\* \* \* \*

Ūrdhvapātana apparatus as described by Nandin. Cf. Vol. i, pp. 124-25.

Koshtī apparatus as described by Nandin. Cf. Vol. i, p. 69.

## Chemistry in Rasaparakasa- sudhakara of Yasodhara.

*Sans. texts, p. 57.*

Preparation of karpūrarasa (lit. camphor of mercury, *i. e.* calomel): practically the same process as given in Vol. i, pp. 250-51.

[Note. Calomel is prescribed here only as an aphrodisiac and a specific for leprosy but not as a remedy for syphilis.]

*Sans. texts, pp 59 61.*

Rasaka (calamine): the author of R. R. S. has evidently borrowed his description of this mineral from the present work. Cf. Vol. i, p. 87.

Extraction of zinc from calamine :

[The process agrees almost word for word with what is given in R. R. S. The essence possessing the lustre of lead runs out of the crucible.\*]

*Sans. texts, pp. 61 62.*

Saurāshtrī or tuvarī (alum-earth) almost identical with R. R. S. Cf. Vol. i, p. 91.

\* \* \* The essence extracted from the alums (*i.e.* oil of vitriol) is to be used for operations with metals and not as medicine.

*Sans. texts, pp. 62-65.*

{ Descriptions of various kinds of pits for calcining and roasting purposes are given ; as also their dimensions with the number of cowdung-cakes to be used as fuel &c. Cf. the typical roasting pit in Vol. i, p. 127.]

\* \* \* \*

Here ends Chapter X of Rasaparakāśasudhākara by Yasodhara, son of Padmanābha.

\* In R. R. S. we have "the essence possessing the lustre of tin."

*Sans. texts, pp. 65-66.*

Hemakriyā or process for the fabrication of gold : "I shall now speak of some curiosities of metals, partly from my own experience and partly from the classics on the subject. Calamine, cinnabar, copper pyrites and realgar are to be rubbed with the milky juice of *Euphorbia neriifolia* for 7 days together and then to be digested another 3 days. Melted copper or silver or lead, being alloyed with the aforesaid mixture, acquires the power of converting 100 times its weight of base metal into gold."\* Cf. *ante, p. 2.*

### **Chemistry in Rasachintamani of Madanantadeva.**

*Sans. texts, p. 68.*

Svetabhasma : Cf. *ante p. 16* and also Vol. i, pp. 250-51.

*Sans. Texts, pp. 69 70.*

Two processes for the fabrication of gold :—  
much the same as already quoted from Yasodhara.

Process for the fabrication of silver :—

Take 1 part of bell-metal, 2 parts of silver, 4 parts of steel (?) \* \* these to be fused with

---

\* शतवेधौ and सहस्रवेधौ are technical terms; for the meaning of वेध *vide* Vol. i, p. 120.

tin and borax ;—by this process will be made silver which will pass current for commercial purposes.

*Saṅs. texts, p. 71.*

Extraction of zinc from calamine :—

The process is much the same as given above (p. 17), with this difference that, whereas Yaso-dhara hits off the completion of reduction when the flame issuing from the pot ceases to be blue, the present author directs that the pot is to be taken out of the furnace as soon as white fumes begin to appear. The crucible is then to be held in an inclined position so that the lead-like essence of calamine drops on the ground.

## **Chemistry in Rasakalpa (Rudra-yamala Tantra.)**

Bowing to Siva, the lord of mercury, and also the feet of Chandīkā, I write this Rasakalpa, the depository of mercurial lore.

### **CHAPTER I.**

Tests for *killed* mercury :—

*Killed* mercury is that which is devoid of (metallic) lustre, not so ponderous, white,\* des-

\* The author previously refers to the red, black, white and even yellow ash (calx) of mercury ; it is not clear why he should here

troyer of metals, divested of fluidity and non-volatile when stirred over a fire. 40 Cf. tests in Rasārṇava in Vol. i, p. 74; as also in Rasaratnākara, ante, p. 9.

Purified mercury should be preserved in the hollow of a tooth or gem or bamboo. 42

## CHAPTER II.

Gold, silver, copper, tin, lead and iron—these are the 6 metals; vartaloḥa, &c., (Vol. i, p. 114) are simply alloys. 1

Honest readers! I beseech you with folded arms to favour my book with your merciful glance.

The mahārasas are 8 in number; *e.g.* mercury, cinnabar, sasyaka, rasāka, &c. ... the rasas are mica, green vitriol and rājāvarta, &c. ... sulphur, orpiment and realgar, &c. are the uparasas as regarded by learned teachers. Cf. Vol. i, pp. 79 and 89.

There are 4 kinds of sulphur:—white, black, yellow and red. Cf. Vol. i, p. 90.

restrict himself to the white variety only. Chloride or sulphide of mercury, when treated with a metal and heated, *kills* (*i.e.* parts with its chlorine or sulphur to) the latter and in that sense it is a destroyer of metals लोहनाशक.

The saurāshtrīs (alums) are of various kinds ; the kāsīsas (vitriols) are of 3 kinds,—namely, kāsīsa proper, pushpa kāsīsa and hīrakāsīsa.\* Cf. Vol. i, p. 91.

Gairika is stated to be of 2 varieties,—the one of golden hue, the other red ; Kaṅkushtā and other rasas are also described by certain teachers ; but these, however, are not referred to here, as we are treading in the footsteps of sages of old.†

\* *Sans. texts*, pp. 75-78.

For the purification of mercury this process is recommended by Svachchhandabhairava and Govinda.

Chūlikalavana (Sal-ammoniac), sulphur and the ash of ginger, &c., digested one hundred times with cow's urine, ... .. make a *vida* for killing gold. Cf. Vol. i, p. 72.

This process for killing [metals] was revealed by Siva and has been transmitted by successive schools of adepts.

\* Hīrakāsa is the name by which green vitriol is known throughout India ; Royle supposes that this word is derived from the Persian *hura* green, and Sans. kāsīsa. (*Antiq. Hindu Med.*) There is no necessity for looking upon hīrakāsa as a hybrid term, seeing that it occurs in the present work in which Mahommedan influence is nowhere traceable.

† Evidently Charaka and Susruta, who mention only a few commonly occurring minerals. *Vide* Vol. i, pp. 29 and 44.

Extraction of the essence of copper pyrites.  
Cf. Vol. i, pp. 70 and 84.

Extraction of zinc from calamine :—

The process is practically the same as given in R. R. S. Cf. Vol. i, pp. 87 88.

I have performed the [aforesaid] experiments with my own hands and have seen them with my own eyes. They are not recorded from mere hearsay or from the dictation of a teacher. These are being promulgated for the benefit of mankind.

### **Chemistry in Rasarajalakshmi of Vishnudeva.**

*Sans. texts, pp. 79-82.*

Give an account of the common rasas and uparasas. Cf. Vol. i, p. 79.

### **Chemistry in Rasanakshatramalika of Mathanasimha, physician to the King of Malwa.**

There are several prescriptions given in which mineral preparations play a conspicuous part. We have quoted only two; in the first, among other ingredients opium occurs; in the second, the

Svachchhandabhairavarasa, probably named after the celebrated alchemist, we have the *calces* of tin, iron and mercury along with other drugs.

## **Chemistry in Rasaratnakara of Nityanatha.**

*Sans. texts, pp. 84-86.*

Test for *killed* mercury :—

When the substance, being heated over a fire of paddy husks, does not further decrease in weight, it should be considered as reduced to a *calx*.

Purified mercury should be stored in the hollow of a tooth or horn or bamboo.

Directions for making factitious cinnabar (Makaradhvaja). Cf. Vol. i, p. 132 (footnote).

## **Chemistry in Dhaturatnamala.**

In the beginning the author after salutation says: "I shall speak of silver, gold, copper, lead, tin and iron as also of calamine, mica, pearls, coral, orpiment, realgar, the pyrites, mercury and diamond,—in fact, the properties of all the metals and minerals and the mode of their incineration."

Killing of silver. Cf. Vol. i, p. 107.

## Chemistry In Rasapradīpa.

Description for preparing mineral acids by distillation :—“ Saṅkha-drāvarasa or liquid for dissolving conchshells,—practically the same as given under “mineral acids” in Vol. i, p. 186. The last line says: “Cowrie-shells and metals dropped into the liquid are at once dissolved.”

Preparation of calomel and treatment of “phirai-garoga” (syphilis) with its application. Cf. Vol. i, p. 252.

## Chemistry in Dhatukriyā or Dhātumanjari (Rudrayamala tantra.)

*Sans. texts, pp. 98 et seq.*

Tin, iron and copper are to be classed among the superior metals.

In general a metal being alloyed with silver is improved in quality. Sattvaja metal (*i. e.* an alloy of tin and copper, *vide* below couplet 15) is of middle quality. 12-14

Synonyms of the different metals. 39-49

Synonyms of zinc: Jāsatva, Yasadāyaka,\* rūpyabhrātā (lil. brother to silver), charmaka, kharpara, rasaka, &c. 50-51

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\* Yasada is the name commonly given to the metal extracted from calamine. *Vide* Vol. i, p. 156.

Pittala is an alloy of copper and zinc. 63

Kāmsyaka is an alloy of tin and copper. 65

Zinc being amalgamated with mercury gives rise to rasaka. 68

[N.B.—Rasaka and kharpara are the names generally applied to the mineral calamine (*vide* Vol. I, p. 158), but here they stand for the metal (zinc) or its amalgam.]

Lead being killed with the aid of gentle heat gives rise to minium (red lead). 69

Copper in combination with the "burning water" gives rise to tuttha (green vitriol).—Thus manifold operations are performed with the aid of *mantras* and apparatus: all these belong to the province of Chemistry. 70-71

Synonyms of haritāla (orpiment): Orpiment is a consumer of mercury and also a clipper of its wings.\* 79

Synonyms of realgar, cinnabar, mica, &c. 81-89

Synonyms of pearls, coral, tortoise-shell, conch-

\* The sulphide of arsenic on being rubbed with mercury and gently heated converts the latter itself into the sulphide. The mercury is thereby *killed* and *fixed*, i. e. deprived of its volatility (clipped of its wings—the Hindu alchemist's favourite figure).

shell, tusk of elephants, the tail of the peacock.  
90-108

Localities for different metals. 113-121

[ The information is very commonplace.]

Localities for copper specified : Nepāl, Kāmārūpa (the eastern portion of Assam), Baṅgala,† the country of the Mlechchhas, Rūma and the country of the Phiraṅgas, &c. 143-145

Localities for zinc : Kāmboja, Rūma, Balkh, &c.  
146

Metals in combination with mercury and sulphur become fit for administration as medicine. 153

\* \* \* \*

Process of roasting a substance in a stout glass-vessel using goat-and-cow-dung-cakes and husks of paddy grains as fuel. 9-10

One part of gold and four parts of zinc are to be melted together and the alloy roasted in a closed crucible . . . the process repeated with the addition of alkalies . . . gold of a reddish yellow colour will thus be generated. 11-17

\* All these have been placed under the category of (हीन inferior dhātu. Though the term dhātu generally means a metal, it is often applied to a mineral; here, however, it covers a much wider field.

\*

† This is the name given to Bengal in many Tantras.

A process for making factitious cinnabar by pouring mercury into its own weight of molten sulphur and then adding three-fourths its weight of orpiment . . . . The mass to be rubbed in a mortar and subjected to sublimation. 23-30

By using the *augmented*\* gold as a means of exchange one can amass wealth. 52

Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth. 85-86

Pure gold is to be alloyed with one hundred times its weight of copper and this [imitation] gold will resemble native gold. 88

Lead and copper being alloyed together will give rise to gold. 97-98

Colophon: Here ends the Chapter on the extolling of gold in Rudra-yāmala.

\* Cf. footnote, p. 2,

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## Chemistry in Suvarnatātra or Svarnatātra.

The origin of the tantra is explained in the opening lines. Parasurāma having given away his worldly possessions to Kasyapa is rendered destitute, and thus has to invoke the aid of the God Siva for his very maintenance.

Siva said: Listen! I shall now reveal to you the most wonderful mysteries of Svarnatātra. 1-10.

A kind of oil is exuded from the bulbous root of a plant; all around it within a radius of ten cubits oily water is exuded and a venomous snake lives under it. If you want to test the properties of the bulb, you should thrust a needle into it, and the needle at once dissolves. Having procured this bulb, rub it with mercury in a mortar and add the oil and subject the mixture to heat in a crucible. The mercury is at once *killed* and acquires the property of converting one hundred thousand times its own weight of the base metal into gold.\* 14-18

Pure orpiment is to be rubbed with this oil for 20 days, and the former is killed thereby and loses its volatility. The 8 metals in the molten state being treated with this prepared orpiment acquire

the power of transmutation. When the above oil is thrown into molten copper, it is turned into gold of beautiful lustre. Tin and bell-metal similarly treated are turned into silver, and copper, iron, brass and silver into gold. 19-24

Śaṅkhadrāvaka (*aqua regia*, see *ante* p. 24) is spoken of as an universal solvent . . . .  
 . . . This solvent with mercury is to be placed in a glazed crucible and subjected to heat; the mercury, thus *killed*, can convert the 8 metals into gold. By partaking of this mercury one becomes immortal; even his urine and fæces can convert copper into gold.\* 1-10

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\* This sort of belief was prevalent also at the time of the composition of Rasārṇava.

## Knowledge of Gems.

A few words on gems may not be considered beyond the scope of the present work especially as the subject has already drawn the attention of some European scholars.\* We shall, however, limit ourselves, as far as possible, purely to the physical and chemical properties of the precious stones.

It has already been seen that among the 64 branches of arts and sciences recognised in the ancient 'Kāmasūtra' of Vātsyāyana occur the following:—(a) the testing [of the genuineness or otherwise] of gold and the gems; (b) knowledge of the colouring of gems, as also of mines and quarries.† Varāhamihira (d. 587 A. D.) in his "Vṛihat Samhitā" also conveys much useful information on this subject, but as he in his turn refers

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\* Garbe in his "Indischen Mineralien" (Leipzig, 1882) gives the text and the translation of Ch. xiii of Narahari's "Rājanighantu"; this work, however, is comparatively modern. Much useful information on the subject with bibliographical references will be found in Professor Yogesa Chandra Rāy's treatise in Bengali entitled "Ratnaparīkshā."

to experts who preceded him,\* it may safely be concluded that long before this time it received adequate attention.

The *Garudapurāna* under the heading of *Ratnaparikshā* (examination of the gems) devotes several chapters to a detailed and fairly exhaustive description of the gems. This *Purāna* like so many of its class discusses on a variety of topics, mundane and spiritual ; in short, it may be looked upon as a sort of *multum in parvo*.

From time immemorial the gems have been valued in India not only for purely decorative and ornamental purposes, but also as agents for warding off perils and the malignant influences of the planets and for securing luck and longevity. Hence it is that particular attention is paid to the testing of gems, as their virtue increases in proportion as they are faultless and flawless.

The typical characters which were most relied upon for differentiating one species of a gem from another were (1) the relative weight, (2) hardness, (3) lustre, transparency and colour, (4) fusibility, especially when heated in combination with the alkalies. It will be noticed that even the lapidaries

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\* पूर्वजाचार्यैः समुद्दिष्टं.

and the mineralogists of the present day have to depend largely upon these properties in the classification of the *stones*. We shall now proceed to say a few words under each of the above characters following in the main the authority of *Garuda-purāṇa*.

1. **RELATIVE WEIGHT.** We have purposely used these terms as contradistinguished from "specific gravity" : as the latter connotes peculiar associations. The principle of Archimedes being evidently unknown among the Hindus, the measurement of volume could only be roughly approximate. To cite some illustrations. A stone may be of the same species as, and equal in volume to, a *padmarāga* (oriental ruby), but will differ in weight from the latter.\*

Empirical and arbitrary scales of weight were adopted as standards. A ruby occupying the volume of a *guñja* (*abrus precatorius*) may be equal in weight to 10, 7 and 3 *guñjas* respectively. A ruby of the volume of a *srigālakola* (a kind of jujube) should weigh 12, 8 and 7 *guñjas* respectively. Again, a ruby of the volume of an *āmalakī* (*phyllanthus emblica*) should weigh 30, 20

\* तुल्यपमावस्थ च तुल्यजातेर्यो वा तुल्यत्वेन भवेन्न तुल्यः ।

and 16 māsās respectively.\* In each case the gem which is of greater weight is superior in quality and the value thereof is enhanced in proportion.†

In the case of precious metals, however, adulteration was detected by an ingenious device, which may be regarded as a near approach to the principle of Archimedes. Suppose it is intended to test the purity of a specimen of gold. All that one has to do is to draw a wire of this gold and another of the standard gold through the self-same orifice [of corundum]. As these wires are of equal

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\* We give below the standard weights as current at the time of Varāhamihira.

|                |                |     |   |                                    |
|----------------|----------------|-----|---|------------------------------------|
| 8 <sup>1</sup> | White mustards | ... | 1 | tandula (a grain of paddy)         |
| 4              | Tandulas       | ... | 1 | gunja ( <i>abrus precatorius</i> ) |
| 5              | Gunjas         | ... | 1 | Múshā                              |
| 16             | Múshās         | ... | 1 | Karsha or suvarna or tolaka        |
| 4              | Karshas        | ... | 1 | pala                               |

The standard of weight has always varied in different times in different parts of India. 10 gunjas weigh about 18 grains. The seeds often vary in size.

† Garuda lays special stress on the high specific gravity (=4.0) of a genuine ruby. खड्गं विजातिलिङ्गं, again गुह्यं मन्त्रीनां गुह्यसंयुतः । While high specific gravity is indicative of the excellence of the gems in general, in the case of diamond it is just the reverse. गुह्यता सञ्चरद्वाणां गौरवाधानकारणम् । नये तत् वैपरीत्येन सूरयः परिचक्षते ॥ It is not easy to account for this qualifying clause, seeing that diamond has a sp. gr. of 3.5.

diameters, equal lengths will have equal weights, provided the sample is pure.\*

2. **HARDNESS.** There are many stones which in external appearance resemble a ruby; the spurious substitute may easily be detected by its difference in softness (low degree of hardness), and low specific gravity: again in case of suspicion the gem is to be rubbed on a whetstone; if it simply gains in lustre but does not lose in weight (by abrasion), the specimen is to be regarded as genuine (test of a ruby).† Diamond and corundum alone will scratch ruby and sapphire. Skilful lapidaries often make imitation diamonds of zircon, ruby, cat's-eye, rock-crystal and glass; hence they are to be tested by calling in the aid of learned experts. All the gems occurring in this world as also the metals will be scratched by a diamond, but the latter will not be similarly affected by the former. .... A diamond alone will scratch a diamond.‡

\* एकच्छिद्रे समाज्ञष्टे समखण्डे द्वयोर्येदा ।

धात्वोः सूत्रं मानसमं निदुष्टस्य भवेत्तदा ॥ Sukranīti.

† This is true in a qualified sense only. After the diamond corundum is the hardest of all known minerals.

‡ The ruby and the sapphire are only varieties of corundum. Varāha classes corundum as a species of ruby, the former being dotted over with black and white patches and feeble in lustre [*i. e.* the non-transparent or coarse kind]. It is scarcely necessary to

To the above tests Rājanighantu adds another, namely, when a diamond is struck with an iron hammer, it is not broken to pieces \*

point out that the very word 'corundum' is derived from the Hindi *kurand*, a corrupt form of the Sanskrit *kuruvinda*. The statement "corundum will scratch ruby and sapphire" is not strictly accurate. There are degrees of hardness among the different varieties of corundum, the blue sapphire standing first in this respect.

We give here the original texts of which we have given above almost a literal translation.

“खेदप्रमेदो मृदुता लघुत्वं विजातिलिङ्गं खलु सार्वजन्यम् ।”

“अप्रणश्यति सन्देहे शिलायां परिचर्षयेत् ।

घृष्टा योऽत्यन्तशोभावान् परिमाणं न मुञ्चति ।

स ज्ञेयः शुद्धजातिस्तु ज्ञेयास्यान्वे विजातयः ॥”

“वज्रं वा कुर्वविन्दं वा विमुष्यान्वेन केनचित् ।

न शक्यं लेखनं कर्तुं पद्मरासेन्द्रनीलयोः ॥”

\* The reading of the text is very corrupt. Garbe gives as many as 12 variants ; that adopted by him seems to be on the whole reliable as also his rendering : “Wenn er mit anderen steinen oder eisernen Hammern geschlagen nicht zerspringt.” On account of its brittleness a diamond will readily be shivered into splinters under the blow of a hammer. The following extract from Bauer and Spencer's "Precious stones" (pp. 129-130) may prove of interest.—

“The hardness of diamond has often been confused with its fragility or brittleness. It has been supposed, especially in ancient and mediæval times that hammer and anvil may be shattered but not the diamond which lies between. This statement was

3. LUSTRE, TRANSPARENCY, COLOUR and other optical properties. Difference in lustre (जेहप्रभेद) is often regarded as a diagnostic feature of the gems. According to Varāha gems of superior qualities should possess cool (lit. waxy) lustre, be limpid and emit rich rays. Classification according to colour is often enjoined. For instance, a diamond may be perfectly colourless, or it may be yellow,

made by Pliny, the great naturalist of ancient days, who was killed in 79 A.D. at the first historic eruption of Vesuvius. He proceeded to say further that the fragmentation of a diamond may be effected by subjecting it to a preliminary immersion in the warm blood of a goat, but that even under these circumstances the hammer and anvil will also be broken! According to Albertus Magnus (1205-1280) the blood is more efficacious if the goat has previously drunk wine or eaten parsley.

"Such being the views then held respecting the unbreakable and indestructible character of the diamond, it is easy to understand why the Greek word *adamas*, signifying unconquerable, should have been applied to this stone, although its application to the diamond is singularly inappropriate and inaccurate when its extreme frangibility is considered. Many a doubtful stone has been submitted to the test of the hammer, with the belief that the blow would be resisted only if the stone were a genuine diamond. Probably many beautiful stones have been sacrificed to this old belief. As a matter of fact, diamond is easily fractured, a very moderate blow from a hammer sufficing for the purpose; its perfect cleavage places it among the most brittle of minerals."

black, red or copper-tinted.\* Stones which are translucent, opaque and of dull colour are inferior in quality. In the case of diamond special stress is laid on its displaying the colours of the rainbow [due to its high dispersive power]. Some gems have only one shade of colour (एकवर्णाय), others again two (द्विवर्णाय).†

The changes in colour which the ruby and the sapphire undergo under the influence of heat had evidently been carefully observed. This test is to be applied with extreme caution as in case the pro-

\* रक्तं पीतं सितं शैरीषं (Varāha); आताम्रं (Garuda).

Yellow diamonds are unknown in India at the present day at any rate. "India can claim for its own all the finely coloured stones of blue, green and red, not however, yellow diamonds, which come mainly from South Africa." (Bauer and Spencer). Crystals of black diamond should not be confounded with the black carbonado.

† Probably refers to dichroism. As has already been pointed out the red ruby and the blue sapphire are only varieties of corundum, which often occur in well-developed crystals belonging to the rhombohedral division of the hexagonal system. "The dichroism of the ruby affords a means whereby it may be distinguished with certainty from other red stones, such as spinel and the different varieties of garnet, which crystallise in the cubic system, and thus being singly refracting can show no dichroism." (Bauer and Spencer). "The dichroism of the sapphires of Siam is specially well marked." —*Ibid.*

per degree of temperature (अग्निमात्रा) is exceeded, the stone may be materially injured.\*

4. FUSIBILITY (LIQUEFACTION). It was well-known that all the gems with the exception of diamond would undergo liquefaction when strongly heated with a mixture of the two alkaline carbonates [now familiar in the Laboratory as the "fusion mixture"]. The liquid principle of gems रत्नजा द्रुति was a favourite remedy with the Hindu Iatro-Chemists (Cf. Vol. i, p 103). As most of the precious stones belong to the corundum and the spinel group, they easily yield to treatment with sodium and potassium carbonates. In the case of the pearls it is recommended that they should be enclosed inside lemons and placed in a mass of paddy grains [for the sake of the warmth].

\* यावन्तं चक्रमेदग्निं पद्मरागोपयोगतः (१) ।  
 इन्द्रनीलमणिसखात् क्रमेत सुमहत्तरम् ॥  
 तथापि न परीक्षाये गुणानामभिष्टुत्यै ।  
 मणिरघौ समाधेयः कथञ्चिदपि कथम् ॥  
 अग्निमात्रा(ऽ)परिज्ञाने दाहदायैश्च दूषितः ।  
 सोऽनर्थाय भवेद्भस्तेः कर्तुः कारयितुस्तथा ॥ Garudā.

Cf. "The red ruby, at a high temperature, is colourless: on cooling it first becomes green, after which it gradually assumes its original fine red colour." (Bauer and Spencer). "The blue colour of the sapphire disappears on heating."—*Ibid.*

## GENERAL AND CONCLUDING REMARKS.

The crystalline character of the minerals is referred to in one or two places. All the old writers agree in describing the diamond as having 6 angles, 8 faces and 12 edges.\* The octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundel Khand. Rājanighantu further adds that the stone is often endowed with numerous faces and edges.† According to Rasaratnasamuchchaya the female diamond is flattened and rounded, whilst the neuter is rounded and obtuse-angled ‡ Vaikrānta is also

\* कोट्यः पार्श्वानि धाराय षडष्टौ हादशेति । Garuda.

† "In most cubes of diamond, however, each edge is replaced by two faces, ... the twenty-four faces thus derived would, if produced or enlarged" sufficiently, give rise to the form known as the four-faced cube, or tetrakis-hexahedron. (Bauer and Spencer).

‡ The rendering of the description of diamond in R. R. S. (*vide* Vol. i, p. 100) is based upon a misreading. The correct reading is that adopted by the Poona edition, namely, षट्फलकं षट्कोणं "a diamond has 8 faces and 6 angles." The author evidently uses फलक and कोण in the same sense; there cannot be any confusion here, as distinct mention is made of the 6 angles. As a rule फलक and कोण are used synonymously. Thus in Varāha वज्र is described as षड्भुज; the commentator Bhaṭṭotpala explains it षड्भिरलिभिर्भुजं षट्कोणमित्यर्थः । "Rounded" (वर्तुल); Cf. Bauer and Spencer. "The faces of diamond crystals differ from those of most other crystallised minerals, in that they are, as a

(probably a mineral of the spinel group, *vide* Vol. i, p. 83) described as having 8 faces and 6 angles.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A. D. by the celebrated Robert Boyle. Bhoja, (11th century A.D.) however, mentions this property.\* Faults in precious stones due to isolated grains of minute gravels etc., embedded in the mass now technically called "enclosures"], are also referred to. †

It may be noted here that what is generally known as the Indian or Tavernier's rule for determining the value of diamond can be traced back to a remote date. Sukranīti speaks of it as the "rule of squares," ‡ while Varāha, himself a great

rule, much curved and rounded instead of being perfectly plane, as is usually the case." p. 119. "Obtuse-angled" (कुण्डकोणाद्य) in the crystallographic terminology should be rendered as "with corners truncated off."

\* चम्बकारे च दीप्यते (phosphoresces in the dark).

† कसुबा मन्दद्युतयो लेखाकीर्णाः सञ्चातवः खण्डाः ।

दुर्विद्या न मनीषाः सञ्चर्करायेति मणिदोषाः ॥ Barāha.

Here सञ्चातवः and सञ्चर्कराः no doubt refer to the minute pebbles (gravels) enclosed in the body of the stones.

‡ यथा मुक्ततरं वज्रं तन्मूल्यं रतिवर्जितः i. e. if a diamond weighing 1 rati be worth x, one of the weight of 4 ratīs will be worth x x x.

mathematician, gives practically the same rule, though somewhat on an elaborate scale. \*

It would be unfair to compare the progress made by the Hindus in this branch of knowledge in the 6th century A.D. and perhaps earlier with that of the present day. Reference to the crystalline forms of diamond can be found in the writings of Keppler, Steno and Robert Boyle in the seventeenth century. Scientific crystallography originated with Romé de l'Isle and the abbé Haüy at the end of the eighteenth century. The various physical and chemical properties of the minerals culled here bespeak considerable powers of keen observation.†

\* सितसर्वपाटकं तण्डुली भवेत्तण्डुलैस्तु विंशत्या ।

तुलितस्य द्वे खल्वे मूल्यं विद्वद्भिरिति चेतत् ॥

पादचंद्रार्धेन विभागपञ्चाशद्विंशत्याशय ।

भागाद्य पञ्चविंशः शतिकाः साहस्रिकाश्चेति ॥

*i. e.* if a diamond weighing 20 tandulas (p. 33 ante) be worth 2 lacs (2,00,000), one weighing 5 tandulas will be worth only  $(5^2 \times 4 = 100)$ th part of 2 lacs or 2,000.

† Concerning Ratnaparikshā cf. also "Les Lapidaires Indiens" by M. Finot in the "Bibliothèque de l'Ecole des Hautes Etudes."

## NOTE ON THE METHOD OF PREPARING CAUSTIC ALKALI.

In the first Volume of our History the detailed description of preparing caustic alkali from the ashes of plants has been quoted at length from the Susruta and we referred to it "as a proof of the high degree of perfection in scientific pharmacy achieved by the Hindus at an early age."\* M. Berthelot has no less been struck with the originality of this process; indeed, he goes so far as to suggest that this portion in the Susruta is evidently modern and in fact a later addition derived from contact with the European chemists. †

The process of rendering mild alkali caustic by the addition of lime is to be found also in Chakrapāṇi (c. 1050 A. D.) and Vāgbhata, who must have preceded the former by several centuries, and it is well known that both these authors are deeply indebted to the Susruta. There is not thus the remotest chance of inspiration from the European chemists.

\* *Vide* Vol. i, Intro. c.

† *Journal des Savants*. Jan. 1903, p. 42.

We have evidence from quite an unexpected and independent source that the cauterization of bad wounds by means of caustic alkali was an established custom in ancient India. Thus we read in "The Questions of king Milinda" :—

"And when the inflammation had gone down, and the wound had become sweet, suppose he were then to cut into it with a lancet, and burn it with caustic. And when he had cauterized it, suppose he were to prescribe an alkaline wash . . . . Now tell me, O king ! would it be out of cruelty that the surgeon . . . . thus cut with the lancet and cauterized with the stick of caustic."\*

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\* "Sacred Books of the East," Vol. XXXV, p. 168. Although Milinda has been identified with the Bactrian Greek king Menander (c. 140—110 B. C.), it is not to be supposed that any Greek influence can be traced in it. In this ethical romance, king Milinda and the Buddhist Bhikshu Nāgasena have been put forward simply "as men of straw" to quote Rhys Davids. The work in reality conveys the teachings of the older Buddhists (Hīnayānists) with the background of Sāṃkhya and Vedānta metaphysics.

## **The Tantrists, the Rosicrucians and the seekers after truth.**

The East has not been always East and the West, West. Modern Europe is materialistic, but she has not disdained in the past to "plunge in thought." This reminds us of the truth of the poet's words: "one touch of nature makes the whole world kin." Ancient Greece had her orphic mysteries. They were developed into a religious and ethical system by Pythagoras. In the schools of Alexandria the neo-Pythagoreans and the neo-Platonists further added to it the Vedantic doctrine of a world-soul.

"With the dissolution of the neo-Platonic school in the sixth century, Greek philosophy disappears, it is true, as a distinct phenomenon from the theatre of history, but it continues to exist in combination with foreign elements in the service of a new form of culture in the Science of the Middle Ages and of modern times." (Zeller)

Says Waite :—

"The traditions of the neo-Platonic philosophy, with its elaborate theurgical system, were to some extent perpetuated through the whole period of the Middle Ages, for besides the orthodox theology of the great Latin Church and amidst the clamour of scholastic philosophy, we find the secret theosophy of the magician, the Kabbalist, and the alchemical adept borrowing, directly or indirectly, from this prolific

fountain of exalted mysticism. The traces of its influence are discoverable in Augustine, in Albertus Magnus, in St. Thomas, the angel of the schools, and in other shining lights of western Christendom, while the metaphysical principles of Johannes Scotus Erigena, even so early as the close of the ninth century, were an actual revival of this philosophy."\*

History repeats itself. In India the Yoga doctrines of Patañjali paved the way for the origin of Tāntric mysticism and it associated itself with magic and alchemy. Some twelve centuries later, this phase in the stage of human progress found exponents in the soil of Europe. As Waite says :—

"In an age of progress, of doubt, and of great intellectual activity, it is singular to remark the almost invariable prevalence of mysticism in one or other of its manifold phases, and the close of the sixteenth century beheld spreading over the whole of Germany and passing thence into Denmark, France, England and Italy, a mighty school of mysticism in the great multitude of magicians, alchemists, &c., who directly or indirectly were followers of the renowned Paracelsus."†

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\* "History of the Rosicrucians," p. 27. Regarding the sect of the Cabalists see also Lecky's "Rationalism in Europe." Vol. i, p. 42. ed., 1900.

† See also Kopp's "Die Alchemie in ält. u. neu. Zeit," ii, pp. 1—146, on the "Bekantschaft mit Geheimnissen der Magie, Theosophie, Alchemie u. A."

Even the lower strata of society in England did not escape the contagion. Sir William Temple observes : " I have had several servants far gone in divinity, others in poetry, have known in the families of some friends, a keeper deep in the Rosicrucian mysteries."

There are those who sneer at the attempts of the alchemists to convert the baser metals into gold and are at the pains to insinuate that the motives of the adepts were sordid. It may be that there have been here and there men—vulgar charlatans—who have pursued the *art* merely from worldly considerations. The high priests of alchemy, however have in every age and clime been honest seekers after truth. Had there been no desire implanted in the human breast to pry into the hidden and occult mysteries of nature there would have been no science. Whence come we and whither are we destined to go ? What is this substance made up of, and what are its ultimate constituents, and what will its combination with this or that lead to ? These are queries, the solution of which or rather the very attempts to solve which mark the birth of philosophy. Patañjali and Nāgārjuna in India and Paracelsus in Europe stand forth as the prominent representatives of

this spirit of inquiry. They have been dreamers, mystics and naturalists all combined in one. Such geniuses have always chafed at the restraints and limitations imposed on frail man and hence their fervid yearnings to peep into regions beyond the ken of our gross senses. As Emerson puts it :—

“The privilege of this class is an access to the secrets and structure of nature, by some higher method than by experience. In common parlance, what one man is said to learn by experience, a man of extraordinary sagacity is said, without experience, to divine.”\*

Plotinus heaved a sigh at the soul with its infinite possibilities being caged in a frail and corruptible body. The pursuit of alchemy by the esoteric *Tāntrist* is easily explained. To him it was only a means to an end. “It (mercury) is alone that can make the body undecaying and immortal.”† We find echoes of the same sentiment in the authoritative literature of the Rosicrucians.

Says Waite :—

“Among the concourse of inquirers, and the clamour of supposed and pretended discoverers, there rose gradually into deserved prominence an advanced school of illuminati,

\* “Swedenborg ; or, the mystic.”

† *Vide* “History of Hindu Chemistry,” Vol. i, Intro. lxxvii and xcv—xcvi.

who, employing the terminology of the *turba philosophorum*, under the pretence of alchemical pursuits appear to have concealed a more exalted aim. . . . The student is directed by these writers from the pursuit of material gold to the discovery of incorruptible and purely spiritual treasures. . . . Physical transmutation, the one and supreme end of the practical alchemist, sinks into complete insignificance ; nevertheless, it is performed by the adept and is a landmark in his sublime progress." l. c. p. 32.

The sage and seer of Hoenheim had his wrestlings. Should he pursue knowledge for its own sake or for what it bringeth ? His evil genius holds out the bait thus :—

" Know not for knowing's sake  
 But to become a star to men for ever ;  
 Know for the gain it gets, the praise it brings,  
 The wonder it inspires, the love it breeds."\*

The spiritual at last triumphs over the base in man. Paracelsus has his revelation, and he bursts forth :—

" Truth is within ourselves : it takes no rise  
 From outward things, whate'er you may believe,  
 There is an inmost centre in us all  
 Where truth abides in fulness : and around  
 Wall upon wall, the gross flesh hems it in,  
 The perfect clear perception—which is truth!"\*

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\* Browning's " Paracelsus."

In the above delineation the poet has done no more than bare justice to the inward longings of an ideal alchemist, who is only an honest seeker after truth. The spiritual and thought-world has always transgressed all barriers of time and space. Kanāda, Patañjali and Nāgārjuna of India and Heraclitus, Empedocles and Plato and the rest—they all form a holy fraternity ; aye, these prophets and oracles of the intellect belong to a "lofty and sequestered class," "the high-priesthood of the pure reason, the *Trismegisti*, the expounders of the principles of thought from age to age. When at long intervals we turn over their abstruse pages, wonderful seems, the calm and grand air of these few, these great spiritual lords, who have walked in the world,—these of the old religion,—dwelling in a worship which makes the sanctities of Christianity look *parvenues* and popular ; for 'persuasion is in soul, but necessity is in intellect.' "

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Emerson : on "Intellect,"



## The metals and their loss in weight after calcination.

Very vague ideas prevailed among the Hindu philosophers on the constitutions of a metal and its fate after calcination. We are reminded of the diversity of opinion in Europe before the time of Lavoisier. A metal like every material substance was supposed to be formed of one or more of the five *bhūtas*; in fact the earthy or saline element was taken to be predominant in it,\* and hence it lent itself so readily to calcination. † It should be noted here that by “*bhūta*” was understood not so much an *element* in the modern connotation of the term as certain qualities of individual substances. Even mercury was regarded as composed of the five *bhūtas*. ‡ When a metal was submitted to calcination some of its component *bhūtas* escaped, leaving the earthy or saline portion behind; hence the ash (*calx*) must weigh less than the original metal itself.

\* पार्थिवाः सुवर्णरजतमणिमुक्तामनःशिलाभूतकपालादयः । Ch. I., 24. Again in Ch. XLVI (Sūtra) 345 et seq. the metals are included among the saline ingredients.

† Cf. “For some maintain that gold is solid light, or, at least that the chief ingredient is light, which is rendered solid by mixture with some particles of earth. Were it mere earth it might be calcined by fire strongly urged.”—Vol. I. p. 9.

‡ पञ्चभूतात्मकः सूक्ष्मिष्ठत्वेन सदाशिवः । इति स्मार्थवे ।

There is, however, no direct reference to be met with anywhere as regards the quantitative aspect of the question so clearly established by Lavoisier.

The proportion of loss which a metal undergoes on ignition was made the basis for determining its purity and we find in the law-books an arbitrary scale fixed. Thus according to Yājñavalkya, "gold is unaffected by fire, while one hundred parts by weight of silver, tin and copper lose (lit. undergo decay to the extent of) two, eight and fifteen parts respectively. \* This is to be taken as referring not to the roasting (killing) of a metal but simply as allowance made to goldsmiths and other artisans for loss incurred in the shape of dross &c. when it is melted in a crucible.

That copper, lead, tin and other base metals (हीनधातवः) when repeatedly calcined are completely reduced to their calces was well known as will be seen throughout the body of the texts. The passage from Rasendra-chūdāmaṇi (p. 14) deserves some notice. Lead of the weight of 30 *palas* is to be calcined till its weight is reduced to a *karsha* ( $=\frac{1}{4}$  *pala*). Even if it be calcined now one thousand times, it will not undergo further reduction in weight. Our author evidently had his experience of lead derived from argentiferous galena, which would leave

\* यदी सुवर्णमपीह द्विपञ्च रजते शते ।

यदी चतुर्विंशति च तानि पञ्चदशानसि ॥

a residue in the shape of a "button" of silver after the lead had been cupelled off. \*

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\* Similar confusion prevailed in Europe up till the end of the 17th century. The following extract from Robert Boyle's "Concerning the Unsuccessfulness of Experiments" will make the point clear.

"Having, upon occasion, had the curiosity not long since to visit some mines of lead and other metals, I find that there is a great difference, and discernible even to the eye, betwixt the several ores ; for instance, of lead, some of which I can show you so like steel, and so unlike common lead-ore, that the workmen upon that account are pleased to call it steel-ore, which being of more difficult fusion than ordinary, they are wont to mix it with other ore, which they call firm-ore, to facilitate the melting of it. And I likewise took notice of an ore, which for its aptness to vitrify, and serve the potters to glaze their earthen vessels, the miners call pottern-ore, and sell it (at least where I saw it digged up) dearer than other ore, from which it differs both visibly enough, and as the workmen affirm in divers other (and those less obvious) qualities ; and yet all these ores, after fusion, do pass indiscriminately under the name and notion of lead. In which therefore it is no wonder, that severer inquiries find a great deal of disparity. I remember I did not long since cause some lead-ore to be tried, which being the most promising that ever I saw, made me suppose it might contain some considerable quantity of silver : but though it proved so rich in lead, as to yield after the rate of seventy pound to the hundred, yet one of the most expert artists in Europe could not extract one grain of silver out of it ; whereas the lead of very many mines, being skilfully examined, will leave behind it, upon the test, a proportion of pure silver. And though this quantity of silver be not considerable enough to make such mines as yield it pass for silver mines :

## Antimony.

Although there is no direct recognition of antimony as a distinct metal, some sort of allusion to it as a variety of lead is not wanting. The reason why antimony was often confounded with lead is that at first sight stibnite may be mistaken for galena. The mineral *sauvirāñjana* or *nīlāñjana* was thus indiscriminately applied both to the sulphides of antimony and of lead (cf. vol. 1., pp. 93-95) That *nīlāñjana* contained a new metal was often suspected though its nature was not properly understood. Thus in *Rasendra-chūdāmaṇi* we have "*nīlāñjana*, mined with *tikshṇa* (cast iron), and heated several times yields a superior kind of lead, which is readily fusible and is of mild black colour."\*

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(or, as we are wont to call them mines-royal) because the silver will not quit the cost of extracting it ; yet such mines though they pass but for lead mines with the metalist, may appear to be mixt mines to the naturalist, who may meet with divers experiments, wherein the little silver that is in them, may make their lead operate differently from that of those ores, which are wholly destitute of silver."—Edition of 1772, p. 323.

\* *Vide Sans. texts*, p. 52. The identical distich occurs also in R. R. S. Cf. vol. 1. p. 119. Cf. also "But to detain you no longer on this subject, give me only leave to strengthen the paradox I have proposed, by the authority of that great and candid chymist *Basilius Valentinus*, who speaking of antimony, after he hath told us, that there are several kinds of it, and especially two ; the one more mercurial and of a golden property, witnessed by the shining streaks or beams it abounds with; the

## **The preparation known as Svarnasindura or makaradhvaja.**

As the "law of definite proportion" was unknown to the ancients, tedious processes were resorted to for the complete conversion of mercury into its sulphide. "Makaradhvaja" even at the present day is a favourite remedy with the Hindu physicians of the Āyurvedic school.\* Let us follow the recipe as given in Rasendra-chintāmaṇi: "when quicksilver is killed with an equal weight of purified sulphur, it becomes hundred times more efficacious; when it is killed with twice its weight of sulphur it cures leprosy; when it is killed with thrice its weight of sulphur it cures mental langour; when it is killed with four times its weight of sulphur it removes grey hair and wrinkles; when it is killed with five times its

other more full of sulphur, but destitute of the golden nature that enriches the former; adds, that there is such a different goodness betwixt the several sorts of antimony, as there is betwixt the several sorts of flesh or fish, which, though agreeing in name and, if you please, in nature, do exceedingly differ in point of goodness, which brings into my mind the great difference which I have found, even visible to the eye, betwixt the several sorts of Antimony."—Boyle's work—l.c. p. 324.

\* If we take the historical meaning of the term "Āyurvedic," the above preparation cannot lay claim to this distinction, for it was unknown at the time of the Charaka and the Susruta and was introduced into the Materia Medica during the Tantric period.

weight of sulphur it cures consumption ; and when it is killed with six times its weight of sulphur it is a panacea for all the ills that flesh is heir to. \* Now 25 parts by weight of mercury can only take up (*i. e.* combine with) 4 parts by weight of sulphur ; the excess of sulphur simply sublimes off unchanged. In the actual preparation of *svarna-sindūra* (Lit. vermilion with gold) the mercury is first made into an amalgam with thin gold leaves and then repeatedly rubbed in a mortar with sulphur. During the process of sublimation (उड़पानन) the excess of sulphur volatilises off as we have already explained and the gold in fine particles remains behind as a residue. The lustrous, crystalline, reddish brown sublimate, which collects nearest the source of heat, † has the formula  $HgS$ . As there is an erroneous impression about the composition of this drug even among educated people in this country we give below the results

- \* तुल्ये तु गन्धके जीर्णे यद्वाप्यतृणो रसः ।  
 द्विगुणे गन्धके जीर्णे सर्वकुष्ठहरः परः ॥  
 त्रिगुणे गन्धके जीर्णे सर्वजायादिनाशनः ।  
 चतुर्गुणे तत्र जीर्णे वल्लीपलितनाशनः ॥  
 गन्धे पञ्चगुणे जीर्णे क्षये क्षयहरो रजः ।  
 षड्गुणे गन्धके जीर्णे सर्वरोगहरो रसः ॥ र. वि.

† Gopālakrishna very properly lays particular stress upon this point.

अग्निटवित्वा ५० सुतामसुहृत् २० बलिं स्वजेम् ।  
 अथः सः रससिन्दूरं सर्वरोगिण्यु योजयेत् ॥ इति रससिन्दूरसंस्कारः ।

of analysis of a sample of "mercury killed with six times its weight of sulphur along with gold."\*

## Identification of metals by their colouration of flames.

Prominent attention should be drawn to the following extract from Rasārṇava (Vol. I. p. 68)

"Copper yields a blue flame \* \* \* \* \*  
that of the Tin is pigeon-coloured ; that of the Lead is  
pale-tinted" \* \* \* \* \*

We are not aware of similar tests being applied anywhere at such an early period as a qualitative test for metals.

## The age of Bhikshu Govinda the author of Rasahrdaya.

There is a belief current in some parts of the Deccan that our Govinda is no other than the celebrated teacher of Saṅkarāchārya.† If there be any historical foundation for the belief Govinda

\* Percentage of sulphur found = 13.89 ; the calculated amount being 13.79 ; not a trace of gold could be detected.

† The following Slokas are cited from Saṅkaradigvijaya in support of the above :—

तस्मिन् भित्तवत्तरुचौ गुहाया हारि नृपुण्यदुपेय स शंकरायः ।

आचार इत्यपदिष्ट स तत्र तस्य गोविन्दपादगुरवे न गुरुर्गतीनाम् ॥

should no doubt be placed in the 8th century A. D. Apart altogether from the question whether at such an early date the progress of chemical knowledge as revealed in *Rasahrīdaya* had been attained in India, the colophon at the end of the work would tell against such an hypothesis (Intro. liii). The author distinctly states that he wrote his book under the auspices of the king of the Kirātas and even throws out a hint that he was of the Buddhist persuasion. We have no valid reasons to believe that Saṅkara, the sturdy champion of Brahminical faith and the mighty dialectician, whose activity proved the ruin of Buddhism in India should have sat at the feet of a Guru of the opposite creed.

व्यासः पराशरमुतः किल सत्यवत्यां तस्यात्मनः शुक्रमुनिः प्रथितानुभावः ।  
तच्छिष्यतामुपगतः किल गौडपादो गोविन्दनाथमुनिरस्य च शिष्यभूतः ॥  
यस्याव तस्य निकटे किल शास्त्रजालं \* \* \* \*

श्रीमच्छंकरदिग्विजयः, ५मसर्गः, verses १०१ and १०५-६ ।

गान्दायनसंस्कृतग्रन्थावलिः—ग्रन्थाङ्कः २१ ।

In the above Slokas Govindanātha Muni is stated to be the preceptor of Saṅkara, the former being himself the pupil of Goudapāda, who in his turn was a pupil of Sukadeva, son of Vyāsa, the well-known compiler of the Vedas. The Govindanātha of the text has been confounded by the commentator, Dhanapati Sūri, with the Buddhist Govinda. It is scarcely necessary to take serious notice of the chronological perspective of the author of the Saṅkaradigvijaya.

## **The Mechanical, Physical and Chemical Theories of the Ancient Hindus.**

*(By Principal B. N. Seal)*

I propose in this paper to give a synoptic view of the mechanical, physical and chemical theories of the ancient Hindus. A chronological survey, even if the materials for it were available, would be here of little account. The origins of Hindu natural philosophy in the speculations of the Bráhmaṇas and the Upanishads, or in the mythology of the Purāṇas, however interesting from the standpoint of '*cultur-geschichte*,' do not come within the scope of the present exposition, which relates to the results of systematic thought as directed to the phenomena and processes of Nature. I have therefore confined myself to an account of natural philosophy as expounded in the principal systems of Hindu thought. The Śāṅkhya-Pātañjala system accounts for the Universe on principles of cosmic evolution, the Vaiśeṣhika-Nyāya lays down the methodology of science, and elaborates the concepts of mechanics, physics and chemistry. The Vedānta, the Pūrva-Mīmāṃsā, and in a less degree, the Bauddha, the Jaina, and the Chārvāka systems, make incidental contributions on points of special interest, but their main value in this regard is critical and negative. The principal authorities followed in this account,—the Vyāsa Bhāṣhya on

*The original constituents and their interaction.* Every phenomenon, it has been explained, consists of a three-fold *arche*, intelligible Essence, Energy, and Mass. In intimate union these enter into things as essential constitutive factors. The essence of a thing (*sattva*) is that by which it manifests itself to intelligence, and nothing exists without such manifestation in the Universe of Consciousness ( *समष्टिबुद्धि* ). But the Essence is only one of three moments. It does not possess mass or gravity, it neither offers resistance, nor does work. Next there is the element of *Tamas*, mass, inertia, matter-stuff, which offers resistance to motion as well as to conscious reflection. ( *तमः शुद्ध करणकम्* ).

But the intelligence-stuff and the matter-stuff cannot do any work, and are devoid of productive activity in themselves. All work comes from *Rajas*, the principle of Energy, which overcomes the resistance of matter, and supplies even Intelligence with the Energy which it requires for its own work of conscious regulation and adaptation. ( *अव्यावृत्त्याम् अहङ्काराभ्यां स्वकार्यापेक्षनने रजस्तद्द्वारः सहकारी भवति । स्वीकारार्थ-तत्त्ववय-व्यवस्थाकरणम् ।* )

The *Gunas* are always uniting, separating, uniting again. ( *अव्योममिदुनाः सर्वे, नैवासादिसम्ययोगो विद्यो नो वा उपपद्यन्ते* ). Everything in the world results from their peculiar arrangement and combination. Varying quantities of Essence, Energy and Mass, in varied groupings, act on one another, and

through their mutual interaction and interdependence evolve from the indefinite or qualitatively indeterminate to the definite or qualitatively determinate. ( एते गुणाः परस्पररोपरक्तप्रविभागाः संयोगविभागधर्माश्चः इतरतरौपाश्रयेण उत्पाज्जितसूक्ष्मयः।—व्यासभाष्य ). But though co-operating to produce the world of effects, these divers moments with divers tendencies never coalesce. In the phenomenal product whatever Energy there is is due to the element of Rajas, and Rajas alone; all matter, resistance, stability is due to Tamas, and all conscious manifestation to Sattva. ( परस्परराक्ताङ्गित्वेऽपि असंभिन्नशक्तिप्रविभागाः—व्यासभाष्य । अन्योव्याक्ताङ्गिभावेन उत्पादितेऽपि द्रव्ये प्रकाशगुणः सत्त्वस्त्वं ज्ञियागुणः रजसएव स्थितिगुणस्तमसएव—विज्ञानभिक्षु योगवार्तिक on व्यासभाष्य, *ibid*—नैवां शक्तयः संकौट्यन्ते—वाचस्पतिमिश्र तत्त्ववैशारदी on व्यासभाष्य *ibid* ).

The nature of the interaction is peculiar. In order that there may be evolution with transformation of Energy, there must be a disturbance of equilibrium, a preponderance of either Energy or Mass-resistance, or Essence over the other moments. The particular *Guṇa* which happens to be predominant in any phenomenon, becomes manifest in that phenomenon, and the others become latent, though their presence is inferred by their effect. For example, in any material system at rest, the Mass is patent, the Energy latent, and the conscious manifestation sub-latent. In a moving body, the Rajas, Energy, is predominant (kinetic), while the Mass or rather the Resistance

it offers is overcome. In the volitional consciousness accompanied with movement, the transformation of Energy ( or work done by Rajas ) goes hand in hand with the predominance of the conscious manifestation, while the matter-stuff or Mass, though latent, is to be inferred from the resistance overcome. ( प्रधानवेलायाम् उपदर्शितसन्निधाना गुणलेपि च व्यापारभावेन प्रधानानर्नीतानुमितास्मिताः—व्यासभाष्य ).

*The starting point.* The starting point in the cosmic history is a condition of equilibrium or equipoise consisting in a uniform diffusion of the Reals. The tendencies to conscious manifestation as well the powers of doing work are exactly counterbalanced by the resistances of the inertia or Mass. The process of cosmic evolution ( परिचलन ) is under arrest. ( सत्त्वराजतमसां साम्यावस्था प्रकृतिः—Pravachana-Sūtra 61, Chap. I. साम्यावस्था अन्तुनामतिरिक्तावस्था अन्तुनाधिकभावेन असहतावस्था अकार्यावस्था इति निश्चयः—विज्ञानमिश्र, *ibid.* )

*Beginning of Evolution.* The transcendental (non-mechanical) influence of the Purusha ( the Absolute ) puts an end to this arrest, and initiates the process of creation. Evolution begins with the disturbance of the original equilibrium. How this is mechanically brought about is not very clear. A modern expounder of the Sāṅkhya supposes that the particles of Sattva, Rajas, and Tamas possess a natural affinity for other particles of their own class, and that when the transcendental influence of the Purusha ends the state of arrest, the

affinity comes into play, breaks up the uniform diffusion, and leads to unequal aggregation, and therefore, to the relative preponderance of one or more of the three Gunas over the others. Thus commences formative combination among the Reals, and consequent productive activity. (संक्रमणम् चारणकसंयोगः नूनाधिकभावेन चयोक्तं संयोगविशेषः। Chap. I. Sutra 66, प्रवचनभाष्य—विज्ञानमिदम् । इष्टिवीज्यत्तीनां इष्टिवीज्येनैव सत्त्वव्यक्तीनाम् एकजातीयतया एकता । सजातीयोपपत्त्यादिना उद्दिष्टासादिकं च युक्तम् *ibid.* Sutra 128, Chap. I.

*Formation of wholes or systems—collocation of Reals:—*Creative transformation accompanied with evolution of motion (परिच्यन्द) and work done by Energy (क्रिया) cannot take place without a peculiar collocation of the Reals (Gunas.) To form wholes or systems (समुदय), it is essential that one Guna should for the moment be preponderant, and the others co-operant. And this cannot be without an unequal aggregation which overthrows the original equilibrium (गुणवैषम्य, नूनाधिकभाव),—in other words, without unequal forces or stresses coming into play in different parts of the system. (गुणविमर्द—वाचस्यति ।) व्यक्तं सक्रियं परिच्यन्दयन्.....समुदयः समवायः । स च गुणानां गुणप्रधान-भावमन्तरैश्च न सम्भवति । न गुणप्रधानभावो वैषम्यं विना । न च वैषम्य-मुपपद्योपमर्दकभावाद्भवे । वाचस्यति, कौमुदी on *kārikā* 16.)

*The Formula of Evolution—*Differentiation in Integration.—Evolution (परिवर्तन) in its formal aspect is defined as differentiation in the integrated (संयुक्त)

विशेष ). In other words, the process of Evolution consists in the development of the differentiated (विशेष) within the undifferentiated (सात्त्वावस्था), of the determinate (निश्चित) within the indeterminate (अनिश्चित), of the coherent (युक्तसिद्ध) within the incoherent (अयुक्तसिद्ध). The evolutionary series is subject to a definite law which it cannot overstep (परिणामक्रमनिश्चय). The order of succession is not from the whole to parts, nor from parts to the whole,—but ever from a relatively less differentiated, less determinate, less coherent whole to a relatively more differentiated, more determinate, more coherent whole. That the process of differentiation evolves out of homogeneity separate or unrelated parts, which are then integrated into a whole, and that this whole again breaks up by fresh differentiation into isolated factors for a subsequent reintegration, and so on *ad infinitum*, is a fundamental misconception of the course of material Evolution. That the antithesis stands over against the thesis, and that the synthesis supervenes and imposes unity *ab extra* on these two independent and mutually hostile moments is the same radical misconception as regards the dialectical form of cosmic development. On the Sāṅkhya view, increasing differentiation proceeds *pari passu* with increasing integration within the evolving whole, so that by this two-fold process what was an incoherent indeterminate homogeneous whole

evolves into a coherent determinate heterogeneous whole.

The different stadia in the order of cosmic Evolution are characterised as follows :—

- (1) The inconceivable, the unknowable, the formless, of which no character can be predicated (अविज्ञा), including Prakṛiti, or the Reals in a state of equilibrium.
- (2) The knowable, the empirical universe, cosmic matter of Experience, things as matter or stuff of consciousness (विज्ञा),—comprising Mahat, the intelligible Essence of the cosmos, evolved by differentiation and integration within the formless, characterless, inconceivable Prakṛiti.
- (3) Individuated but still indeterminate stuff bifurcating into two series—Subject-experience and Object-experience,—comprising on the one hand the indeterminate unity of apperception or the empirical Ego, as the co-ordinating principle of the Subject-series (अविज्ञा), and on the other hand, the indeterminate material potencies, the subtile vehicles of potential Energy (सम्भाव, प्रवृत्ति), the ultimate subtile constituents of the Object-series (the material world). The previous stadium, the cosmic matter of Experience (विज्ञा, महत्) evolves within itself,

by differentiation and integration, an individuated but still indeterminate stuff in two co-ordinated series, Subject and Object.

- (4) Determinate stuff ( *विशेष* ) evolved within the indeterminate by further differentiation and integration, *viz.*, in the series of Subject-experience, sensory and motor stuff; and in the Object series, a corresponding atomic matter-stuff actualising the material potencies in the form of specific sensible Energies. The latter includes the different classes of *Paramāṇus*, the different kinds of atomic constituents of different kinds of gross matter ( *स्थूलभूत* ).

- (5) Coherent and integrated matter-stuff, individual substances, characterised by generic and specific properties, which however are not rigidly fixed, but fluent being subject to a three-fold change and constantly evolving, ( *अयुतसिद्धावयवमैदानुगतः समूहः द्रव्यमिति पतञ्जलिः—व्यासभाष्य, Sutra 44, Chap. III. सामान्यविशेषसमुदायो द्रव्यं—व्यासभाष्य, *ibid.* सामान्यविशेषात्मा चतुर्वी चर्ची, *ibid.* चर्चीणां चर्चलक्षणावस्थापरिणामः ).*

- (6) And so the cosmic series moves on in ascending stages of unstable equilibrium. ( *विसृष्ट्यपरिणामः* ) until the reverse course of equilibration and dissipation of Energy

(सहस्रपरिणाम and सामान्यता), which even now constantly accompanies the evolution and transformation of Energy, completes the disintegration of the universe into its original unmanifested ground, the unknowable *Prakṛiti*.

The order of Cosmic Evolution according to the व्यासभाष्य (Sutra 19, Pada II) is shown below, in a tabular form :—

*Prakṛiti*, the unmanifested unknowable ground  
( गूढमध्यममलिनम् )

Cosmic matter of experience ( महत्, लिङ्गं )

1

Subject series ( चक्षिण )

Individuated indeterminate mind-stuff  
(unity of apperception, empirical Ego,  
(चक्षिता)

Object series ( चक्षिण )

Individuated but indeterminate matter-stuff  
(subtile material potencies, ( तन्मात्र )

Determinate mind-stuff  
( चक्षिण ) sensory and motor psychoses, etc.  
(आनेन्द्रिय, कर्मेन्द्रिय and मनः)

Determinate matter-stuff  
( चक्षिण ) atomic and molecular constituents of gross matter ( परमाणु—अणुभूत )

Coherent and integrated matter-stuff (अयुतसिद्धावयवः समूहः सङ्घातः द्रव्यं).

Individual substances, with generic and specific characters subject to constant change or evolution *e.g.* inorganic objects composed of atoms or molecules (परमाणु), vegetable organisms (वृक्ष), animal organisms (शरीर) (अयुतसिद्धावयवः सङ्घातः शरीरं वृक्षः परमाणुरिति-व्यासभाष्य, Sutra 44, Pada III).

तच्च तत्. संसृष्टं विविच्यते क्रमानुसंहितैः, तथा षड्विंशतिः लिङ्गमात्रे संसृष्टा विविच्यन्ते, परिणामक्रमनिबन्धात्, तथा तेषु अविशेषेषु भूतैर्न्द्रियाणि संसृष्टानि विविच्यन्ते, न विशेषेभ्यः परं तत्त्वान्तरमस्ति तेषाम् अर्थात्तत्त्वानु-वक्षापरिणामा व्याख्यायिष्यन्ते । (व्यासभाष्य, Sutra 19, Pada II.)

*N.B.*—The usual order given in the Sāṅkhya compendiums is as follows :—*Prakṛiti*, *Mahat*, *Ahaṅkāra*,—and then the bifurcation, *viz.* 11 organs sensory, motor and common sensori-motor from *Rājasic Ahaṅkāra*, and *Tanmātras* from *Tāmasic Ahaṅkāra*,—and finally the *Paramāṇus* of the *Sthūla-Bhūtas*.

The conservation of Energy (and of Mass)—the transformation of Energy :—

The *Guṇas* (Reals), though assuming an infinite diversity of forms and powers, can neither be created

nor destroyed. The totality of the Mass (Tamas), as well as of Energy (Rajas) remains constant, if we take account both of the manifested and the unmanifested, the actual and the potential. But the individual products of the evolutionary process, the concrete phenomenal modes resulting from the combined action of the original Mass, Energy and Essence, are subject to addition and subtraction, growth and decay, which are only due to changes of collocation, and consequent changes of state from the potential to the actual, (in other words, from the future to the present and from the present to the past, in a time series,)—changes, which are illusorily ascribed to the Reals themselves. The different collocations of Mass and Energy give birth to the divers powers of things, the various forms of Energy which may be classed as like and unlike; indeed the course of Evolution from the Reals conforms to a fixed law, not only as regards the order of succession, but also as regards the appearance (and mutual relations) of like and unlike Energies. And this transformation is constantly going on,—the course of Evolution is not arrested for a moment.

गुणास्तु सर्वधर्मानुपातिनः न प्रत्यक्षमयन्ते नोपजायन्ते व्यक्तिसिद्धेः  
 चतुर्ताऽनागतव्यययोगमवतीमिः गुणान्वयिनीमिः उपजनापायधर्मका इव  
 प्रत्यवभासन्ते ( व्यासभाष्य, Sutra 19, Pada II. ) परिचामिनिवृत्ता  
 गुणानाम् । सर्वमिदं गुणानां सन्निवेशविशेषमात्मम् । ( *ibid.* Sutra  
 13, Pada IV. ) एते गुणाः तुल्यजातीयातुल्यजातीयवृत्तिभेदानुपातिनः  
 ( *ibid.* Sutra 19, Pada II. ) परिचामनकमनियमान् ( व्यासभाष्य, :

Sutra 19, Pada II.) कर्मण्येव परिणामोऽस्ति चेदुः (*Patanjali*  
Sutra 15, Pada III.) प्रकृतिः परिवर्तनमधीता अवलम्बपरिणाम  
मावतिष्ठति ।

The doctrine of Causation, a corollary from the conservation and transformation of Energy :—the principle of collocation—the storing-up and the liberation of Energy :—

The Sāṅkhya view of causation follows at once as a corollary from this doctrine of the conservation and transformation of Energy. As the total Energy remains the same, while the world is constantly evolving, cause and effect are only more or less evolved forms of the same ultimate Energy. The sum of effects exists in the sum of causes in a potential (or un-evolved) form. The grouping or collocation alone changes, and this brings on the manifestation of the latent powers of the Guṇas but without creation of anything new. What is called the (material) cause or sum of material causes is only the power which is efficient in the production or rather the vehicle of the power. This power is the unmanifested (or potential) form of the Energy set free (उक्तवर्ति) in the effect. But the concomitant conditions are necessary to call forth the so-called material cause into activity. When the favourable combination or co-operation of concomitants is wanting, there is no manifestation of the effect. The question is—what is the aid which the concomitant conditions render to the deter-

mination (and production) of the effect existing in potency in its material cause? First there is the merely mechanical view as illustrated by some commonplace examples, *e.g.*, the manifestation of the figure of the statue in the marble block by the causal efficiency of the sculptor's art, or of the oil in the linseed by pressing, or of the grain of rice out of the paddy by the process of husking. In these cases the manifestation of an effect is only its passage from potentiality to actuality, a stadium in the process of evolution from possible (future) existence to actual (present) existence; and the concomitant condition (सहकारिणः) or efficient cause (निमित्तकारण), the sculptor's chiselling, the pressing, the husking, is a sort of mechanical or instrumental help to this passage or transition. कार्यशक्तिमन्मेव उपादान-कारणत्वम् । सा शक्तिः कार्यस्य अनागतत्वस्या एव । स एव विशेषः (उत्पत्तेः प्राक् कारणे विशेषः) अस्माभिः कार्यस्य अनागतत्वस्या इत्युच्यते । ( विज्ञानभिक्षु-प्रवचनभाष्य, Sutra 115, Chap. I.) अभिप्रेतः वर्तमानत्वस्या । कारणव्यापारोऽपि कार्यस्य वर्तमानत्वस्य परिणाममेव जनयति । यथा शिलानिष्ठस्य प्रतिमायाः शैलिक-व्यापारेण अभिव्यक्तिमात्रं तिलस्य तैलस्य च निष्पीडनेन चान्वस्यतश्चलस्य च अवघातेन । ( विज्ञानभिक्षु-प्रवचनभाष्य, Sutra 129, Chap. I.)

These mechanical examples of the Kapila-Sāṅkhya have the merit of simplicity, but the Patañjali-Sāṅkhya brushes them aside, and explains causation on the basis of the conservation and transformation of Energy, advancing it as the liberation of potential Energy existing

stored up in a Guna collocation, (the sum of material causes) the liberation following on the action of the proximate efficient cause, or concomitant condition (निमित्तकारण).

The causal operation of concomitant conditions (efficient causes) lies only in this that they supply a physical stimulus which liberates the potential Energy stored-up in a given collocation. Everything in the phenomenal world is but a special collocation of the ultimate Reals (Energy, Mass and Essence). The sum of (material) causes potentially contains the Energy manifested in the sum of effects ; and in the passage from potency to actualisation, the effectuating condition (the concomitant cause,) when it is itself accomplished, is only a step in the evolutionary series, which adds a specific stimulus, and renders determinate that which was previously indeterminate. When the effectuating condition is added to the sum of material conditions, in a given collocation, all that happens is that a stimulus is imparted, which removes the arrest, disturbs the relatively stable equilibrium, and brings on a liberation of Energy (उद्धतवृत्तिशक्ति) together with a fresh collocation (गुणसन्निवेशविशेष). सर्वमिदं गुणानां सन्निवेशविशेषमाद्यम् इति परमाद्यतो गुणात्मानः (व्यासभाष्य, Sutra 13, Pada IV.) सतश्च फलस्य निमित्तं वर्तमानोक्तं समर्थं न अपूर्वोपजनने। सिद्धं निमित्तं नैमित्तिकस्य विशिष्टानुपपन्नं कुर्वति। आपूर्वमुत्पादयति। (व्यासभाष्य, Sutra 12, Pada IV.)

Describing the production of bodies ('organic vehicles') for individual souls, out of matter of Prakriti, under the influence of their merit and demerit, as concomitant conditions, Patañjali points out that non-material concomitants like merit and demerit do not supply any moving force or Energy to the sum of material conditions but only remove the arrest (the state of relatively stable equilibrium) in a given collocation, even as the owner of a field removes the barrier in flooding his field from a reservoir of water. This description is intended to represent the super-physical influence of non-material concomitants (or causes) like volition, merit and demerit, etc., but the causal operation of a material concomitant condition is essentially the same ;—there is the same reservoir of stored-up Energy in a given collocation,—the same condition of arrest or relatively stable equilibrium,—the same liberation of the stored-up potential Energy which flows along the line of least resistance ;—the only difference being that in the case of material concomitants the stimulus which removes the arrest is physical, instead of being transcendental as in the case of non-material causes like will, merit and demerit, etc.

The Vyāsa-bhāṣya helps us to a clear mental representation of the details of this process, being perhaps the finest example before Newton of the exercise of a Scientific Imagination, and as memor-

able as any in the whole history of thought containing as it does the theory of potentials as in a nutshell :—As the owner of many fields can irrigate, from a field which is already flooded, others of the same or a lower level, without forcing the waters thereto with his hands, and merely by making an opening in the barrier or dyke, on which the waters rush in by their own force ;—or further, as the same person cannot force these waters, or the earthy matters held in solution therein, into the roots of the rice plants, but only removes the obstructive grasses and weeds, on which the fluids of their own power enter the roots ;—such is the action of an effectuating condition ( निमित्त ) added to a sum of material causes or conditions.

निमित्तम् अग्रयोजकं प्रकृतोर्णा वरचसिदक्षु ततः चेन्निकवत् । (Patanjali Sutra 3, Pada IV.) न हि धर्मादि निमित्तं यथा चेन्निकः केदारान् अपां पुरस्तात् केदारं पिशाचयिषुः समं निम्नं वा निकतरं वा नापः पाणिनाप-क्षयति आचरणं तु आसां भिनत्ति तन्निकं भिन्ने स्वयमेवापः केदारान्तरम् आग्रावयन्ति ।

Chain of Causation—fixed order. The order of Evolution with the transformation of the Energies follows a definite law. The unalterable chain of causes and effects in the phenomenal world illustrates this fixed order. But though the cosmic order is one and fixed, it comprehends divers series arising from different combinations of the original Gunas, which constitute subordinate or particular laws of cause and effect. (कामात्मनं परिणामात्मनो हेतुः, Patanjali Sutra 15, Pada III.)

What we call the qualities of things are only modes of Energy acting in those collocations. योग्यतावच्छिन्ना वर्तमानः क्षणिकैव धर्मः—स च फलप्रसवमिदामुमितसङ्गवः । (व्यासभाष्य, Sutra 14, Pada III.) ते क्षणिकी धर्मा वर्तमाना व्याप्ता-  
त्मानः, अतीतादुनागताः सुखात्मानः सर्वमिदं गुणानां सन्निवेशमावमिति  
परमार्थतो गुणात्मानः । (व्यासभाष्य, Sutra 3, Pada IV.) And  
these various Energies are sometimes actual (kinetic), sometimes potential, rising to actuality,  
and sometimes sublatent, subsiding from actuality into sublatency. In fact, the original Energy is one  
and ubiquitous, and everything therefore exists in everything else, *potentialiter* (सर्वं सर्वभावावमिति),  
without prejudice to the generic and specific differences of things (जात्यनुष्ठेदेन सर्वं सर्वभावं.) Inor-  
ganic matter, vegetable organisms, and animal organisms are essentially and ultimately one (जलभूयोः  
पारिवात्मिकं रसादिवैश्वर्यं स्यादरेषु द्रष्टं तथा स्यावराणां जलमेषु जलमानां  
स्यावरेषु) so far as Mass and Energy are concerned, but the varied forms of Energy and the generic and  
specific qualities (or properties) of things, which are but modes of Energy, follow a definite unal-  
terable law in the order of their appearance and suc-  
cession, under conditions of space, time, mode and causality, and hence all effects do not manifest  
themselves at once ईशकाशाकारनिमित्तापवन्नात् न खलु  
समानकालम् आत्मनामभिव्यक्तिः ( *ibid.* Sutra 14, Pada III. )  
यो यस्य धर्मस्य समनन्तरी धर्मः स तस्य क्रमः । पिच्छः प्रचयते षट् उपजायते  
इति धर्मपरिणामक्रमः । लक्षणापरिणामक्रमः षट्सु प्रमाणदत्तावात् वर्तमान-  
भावक्रमः, तथा पिच्छस्य वर्तमानभावात् अतीतभूतक्रमः । ( व्यासभाष्य,  
Sutra. 15, Pada III. )

Time, Space, and the Causal Series :—

A *Tanmātra* (infra-atomic particle of subtle matter) is conceived by our understanding to stand in three relations—(1) position in Space (देशावच्छिन्न), (2) position in the Time-series (कालावच्छिन्न) and (3) position in the causal series (निमित्तावच्छिन्न.)

These three relations are the work of the intuitive stage of knowledge as opposed to the conceptual (निर्विकल्पप्रज्ञा as opposed to सविकल्पप्रज्ञा.) But this is not the pure relationless intuition of Reality (निर्विचारा निर्विकल्पप्रज्ञा) which may be termed intellectual intuition, but the intuition that imposes its forms on the Real substrate (सविचारा निर्विकल्पप्रज्ञा) or in other words empirical intuition. तत्र भूतसूक्ष्मेषु अभिव्यक्तवर्षकेषु देशकालनिमित्तानुभवावच्छिन्नेषु या समापत्तिः सा सविचारा इत्युच्यते । तथापि एकबुद्धिनिर्गोचरमेव उदितवर्षविशिष्टं भूतसूक्ष्मालम्बनीभूतं समाधिप्रज्ञायामुपतिष्ठते । (व्यासभाष्य. Sutra. 44, Pada I.)

Infinite Time is a non-entity objectively considered, being only a construction of the Understanding बुद्धिनिर्गोचर) based on the relation of antecedence and sequence, in which the members of the phenomenal series are intuited to stand to one another. These phenomenal changes as intuited by us in the empirical consciousness fall into a series, which the Understanding conceives, as order in Time. The Time-series, then, is a *schema* of the Understanding for

representing the course of Evolution. The *schema* of the Understanding supervenes on the phenomenal world as order in time, and hence in the empirical consciousness the Time-series appears to have an objective reality, and to form a continuum. As there is an ultimate and irreducible unit of extensive quantity (परिमाण) in the *Gunas* or infinitesimal Reals of *Prakṛiti*, which are without constituent parts, so the moment may be conceived as the ultimate and irreducible unit of this time-continuum as represented in the empirical consciousness. A moment therefore cannot be thought of as containing any parts standing in the relation of antecedence and sequence. If change is represented by the Time-series, a moment as the unit of time may be supposed to represent the unit of change. Now all physical change may be reduced to the motion of atoms in Space, and we may therefore define the moment as representing the ultimate unit of such change—*viz.*, the\* (instantaneous) transit of an atom (or rather a *Tanmātra*) from one point in Space to the next succeeding point. Even an atom has constituent parts (the *Tanmātras*), and hence an atom must take more than one moment to change its position. The motion of that which is absolutely simple and without parts from one point in Space to the next must be instantaneous, and conceived as the absolute unit of change

( and therefore of time, अथ.) If this is held to be an irreducible absolute unit, it will follow that what we represent as the time-continuum is really discrete. Time is of one dimension. Two moments cannot co-exist. Neither does any series of moments exist in reality. Order in Time is nothing but the relation of antecedence and sequence, between the moment that is, and the moment that went just before. But only one moment, the present, exists. The future and the past have no meaning apart from potential and sublatent phenomena. One kind of transformation, to which a thing is subject, is that it changes from the potential to the actual, and from the actual to the sublatent. This may be called the change of mark (लक्षणापरिणाम) as opposed to change of quality (गुणपरिणाम), and the change due to duration or lapse of time (अवस्थापरिणाम). The present is the mark of actuality,—the future, the mark of potentiality,—and the past, of sublatency,—in a phenomenon. Only one single moment is actual, and the whole Universe evolves in that one single moment. The rest is but potential or sublatent.

अव्यक्ततत्त्वमयोनीलि वस्तुसमाहार इति बुद्धिसमाहारः सुरुर्ताहोरावादयः । स खल्वेयं कालः वस्तुमयो बुद्धिनिर्माणः ब्रह्मज्ञानानुपाती । लौकिकानां व्युत्थितदर्शनानां वस्तुस्वरूप इव अवभासते । अथस्तु वस्तुपतितक्रमावस्थयोः क्रमस्य प्रमाणमनर्थाका । तं कालविदः काल इति आचक्षते योजिनः । न च यो अव्यक्तो सङ्ग भवतः, क्रमस्य न ह्ययोः सङ्गभूयोरसम्भवात् पूर्वव्यादुत्तरभाविनो यद्व्यवस्थायै अवस्थ स क्रमः । सुखान् वर्तमान एवेकः अथ न पूर्वोत्तरव्याः

सन्तीति तन्मात्राणि तत्त्वमाहारः । ये तु भूतभाविनः क्षणाः ते परिचामान्विता व्याख्यायाः । तेनैकेन क्षणेन कृच्छ्रो लोकाः परिणाममनुभवति, तत्क्षणावृद्धाः स्वल्पमौ क्षणाः । यथाऽपकर्षपर्यन्तं द्रव्यं परमाणुः एवं परमाणुपकर्षपर्यन्तः कालः क्षणः । यावता वा समयेन चलितः परमाणुः पूर्वदिशं गच्छात् उत्तरदिशम् उपमन्येत स कालः क्षणः, तत्प्रवाहाविच्छेदस्तु क्रमः । (व्यासभाष्य, Sutra 52, Pada III.)

Vijñāna-bhikshu points out that this does not amount to a denial of Time. It means that time has no real (or objective) existence apart from the 'moment'. But the latter is real, being identical with the unit of change in phenomena (गुणपरिणामस्य क्षणत्ववचनात्). But even this is real only for our empirical (relative) consciousness (व्युत्थितदर्शन), which intuites the relation of antecedence and sequence into the evolving Reals (Guzas), in the stage of 'empirical intuition' (सविचारा निर्विकल्पप्रज्ञा). The 'intellectual intuition' (निर्विचारा निर्विकल्पप्रज्ञा) on the other hand, apprehends the Reals as they are, without the empirical imported relations of Space, Time and Causality.

Space as extension and Space as position :—

Space must be distinguished as Desa (locus, or rather extension) and Dik (relative position). Space (Dik) as the totality of position, or as an order of co-existent points, is wholly relative to the Understanding, like order in time, being constructed on the basis of relations of position intuited by our empirical (or relative) consciousness. But there is this difference between Space-order and Time-order :—there is no unit of Space as position (Dik),

though we may conceive a unit of Time, viz., the moment ( क्षण ) regarded as the unit of change in the phenomenal or causal series ( प्रमाणक्रियः ०। गुणपरिणामस्य क्षणत्ववचनात्—योगवार्तिक, Sutra 51, Pada III.) Spatial position (Dik) results only from the different relations in which the all-pervasive Akāśa stands to the various finite (or bounded) objects. On the other hand, Space as extension or locus of a finite body, Desa. (देशः स्थित्याधारः), has an ultimate unit, being analysable into the infinitesimal extensive quantity inherent in the Reals (Gunas) of Prakṛiti. (गुणप्रकृतेरक्षणपरिणामः—योगवार्तिक। एतेन नित्या दिगपि अप्रामाणिकी व्याख्याता. सामान्यतो दिग्गवहाराभावात्। पूर्वादित्रयवहारास्य दिग्गवहाराभिर्गव सम्भवात्। सामान्यतः कालदिग्गवहारासत्त्वेऽपि आकाशादेव तदुपपत्तेश्च। कालाच्च दिश्यं विशेषः यत् कालः क्षणरूप इष्यते, दिक् तु सर्वथैव नश्यति।

*The Causal series.*—The relation of Cause and Effect has been already explained. It only remains to add that the category of causality is mediated through the *schema* of order in Time. The Empirical Intuition first superimposes relations of antecedence and sequence on changing phenomena (the evolving Gunas or Reals) and the Understanding out of these relations creates order in Time. The Empirical Intuition then intuits the phenomenal series of transformations of Energy in this Time-order and in so doing, imports the relation of cause and effect into the course of Nature. (कार्यकारणमादादीनां क्षणवर्तितत्वात्—योगवार्तिक, Sutra 51, Pada III.)

The dissipation of Energy (and of Mass)—their dissolution into the formless Prakṛiti :—Cosmic Evolution (परिणाम) is a two fold process, creative as well as destructive, dissimilative as well as assimilative, katabolic as well as anabolic (अनुलीनसर्ग and विलीनसर्ग, विसृष्ट्यपरिणाम and सृष्ट्यपरिणाम.) In one aspect, there is the aggregation (unequal aggregation) of Mass and Energy, with consequent transformation of Energy, resulting in the creation of inorganic as well as organic matter, and the genesis of worlds. The successive steps of this process may be described as (1) unequal aggregation with storing-up of Energy in a certain collocation, under a state of arrest (i.e. in a state of relatively stable equilibrium), (2) a stimulus removing the arrest, and disturbing the equilibrium, and (3) liberation of the Energy, moving on to a fresh collocation, fresh aggregation, arrest and equilibrium. The process of the world thus moves on from equilibrium to equilibrium, and the result of that process is the development of a coherent determinate heterogeneous whole (लिङ्ग अविशेष विभक्ते, अयुतसिद्धावयवसमूह, युतसिद्धावयवसमूह) in what is essentially an incoherent indeterminate homogeneous whole (अलिङ्ग.)

But there is a second aspect of this evolutionary process. Unequal aggregations are unstable, there is a constant tendency in things to go back to the original stable equilibrium,

the state of uniform equal diffusion of Reals. This process is called the resolution of like to like (सदृशपरिणाम), consisting in assimilation and dissipation, and being the exact opposite of the process of "differentiation in the integrated" which has evolved the Cosmos. The collocations of Mass, Energy, and Essence are always breaking up, and the Energy as well as the Mass, however slowly, however imperceptibly, are being dissipated *i.e.* dissolved into the original formless Prakṛiti a state of permanent equilibrium and arrest, from which there is and can be no return, except under the transcendental influence of the Absolute at the commencement of a new creative cycle. Not that there is a destruction of the Mass or Energy, but a dissipation or dissolution into a condition of equal uniform diffusion from which there is no return. This is not the phenomenon of kinetic Energy disappearing and becoming potential or sublatent, for in such cases there is restitution or reconversion by natural means. When this reverse current of assimilation (and dissipation) prevails over the current of dissimilation (and integration), the Universe will disintegrate more and more, until it disappears in the formless Prakṛiti, its unknowable source and ground. (तत्त्ववय and कौमुदी).

The Evolution of matter ( तात्त्विक सृष्टि ) :—

The ultimate constitution of Matter is a question of the profoundest interest in the Sāṅkhya-Pātañ-

jala system. Three stages clearly stand out in the genesis of Matter :—(1) the original infinitesimal units of Mass or inertia, absolutely homogeneous and ubiquitous, on which Energy does work, when the original equilibrium comes to an end (भूतादि—तान्मात्राकार), (2) The infra-atomic unit potentials, charged with different kinds of Energy, which result from the action of Energy on the original units of Mass, ( तन्मात्र ), and (3) the five different classes of atoms, the minutest divisions of which gross matter is capable, but which are themselves complex Tanmátric systems ( सूक्ष्मभूतपरमाणु. )

The first stadium Bhútádi is absolutely homogeneous and absolutely inert, being devoid of all physical and chemical characters ( रूपादिभिरसंयुत ) except quantum or mass ( परिच्छिन्नत्व, परिमाण ); and this admits neither of addition nor of subtraction, can neither be created nor destroyed. The second stadium Tanmátra represents subtile matter, vibratory, impingent, radiant, etc., instinct with potential energy. These potentials arise from the unequal aggregation of the original mass-units in different proportions and collocations with an unequal distribution of the original Energy ( Rajas ). ( तन्मात्र रूपादिः किं कारणम् इति चेत् स्वकारणद्रव्याणां न्यूनाधिकभावेन अन्योऽन्यं प्रति संयोगविशेष एव—स्वजातीयोपपत्त्यादिना वृद्धिक्लृप्तादिकं च युक्तं ). The Tanmátras possess something more than quantum of Mass and Energy. They possess physical characters, some of them penetrability

(चक्रकायदान), others powers of impact or pressure, others radiant heat, others again capability of viscous and cohesive attraction. In intimate relation to these physical characters they also possess the potentials of the energies represented by sound, touch, colour, taste and smell, but being subtile matter they are devoid of the peculiar forms (विशेष) which these potentials assume in particles of gross matter like the atoms and their aggregates. In other words, the potentials lodged in subtile matter must undergo peculiar transformations by new groupings or collocations to be classed among sensory stimuli,—gross matter being supposed to be matter endued with properties of the class of sensory stimuli, though in the minutest particles thereof the sensory stimuli may be infra-sensible, (अतीन्द्रिय but not अदृश्य). (तस्मिन्संविद्यते तन्मात्राः ते च अविशेषिताः । ते च पदार्थाः ज्ञानचरमुदाहृताः स्थूलगत-शब्दादिविशेषैः शृङ्गा एकरूपत्वात् । तथाच ज्ञानादिविशेषशब्दादिमत्त्वमेव कृतानां शब्दादितन्मात्रत्वम् ।)

The Tanmātras, then, are infra-atomic particles charged with specific potential energies,—first, the potential of the sound stimulus is lodged in one class of particles, Tanmātras which possess the physical energy of vibration (परिस्फन्द), and serve to form the radicle of the ether atom (आकाशपरमाणु), then the potential of the tactile stimulus is lodged in another class of Tanmātras, particles which possess the physical

energy of impact or mechanical pressure in addition to that of vibration and serve to form the radicle of the gas atom (Vāyu Paramāṇu) ;— next, the potential of the colour stimulus is lodged in a third class of Tanmātras, particles which are charged with the energy of radiant heat and light in addition to those of impact and vibration and serve to form the nucleus of the light and heat corpuscle ; then the potential of the taste-stimulus is lodged in other Tanmātras, particles which possess the energy of viscous attraction, in addition to those of heat, impact and vibration, and which afterwards develop into the atom of water, and lastly, the potential of the smell-stimulus is lodged in a further class of Tanmātras, particles which are charged with the energy of cohesive attraction, in addition to those of viscous attraction, heat, impact and vibration and which serve to form the radicle of the earth atom.

षड्विशेषाः तद्यथा शब्दतन्मात्रं स्पर्शतन्मात्रं रूपतन्मात्रं रसतन्मात्रं गन्धतन्मात्रञ्च इत्येकं हि चतुष्टयमवधार्यः शब्दादयः षड्विशेषाः । व्यासभाष्य, Sutra 19, Pada II. षडङ्गरात् शब्दतन्मात्रं तत्सङ्गहद्वारसङ्कतान् शब्दतन्मात्रात् शब्दप्रशङ्गं स्पर्शतन्मात्रम् । एवंक्रमेण एकैकगुणसङ्गहो तन्मात्राणि उत्पद्यन्ते (प्रवचनभाष्य—Sutra 62, Chap. I.)

शब्दादीनां सूक्ष्ममनजातीयानाम् एकः परिणामः पृथिवीपरमाणुः तन्मात्रवयवः । भूतान्तरं अपि खेहीच्छाप्रणामित्वाऽवकाशदानानि उपादाय सामान्यम् एकविकारारम्भः समाधेयः । ( व्यासभाष्य, Sutra 14, pada IV.) तद्यथा गन्धतन्मात्रं वर्जयित्वा चतुस्तन्मात्राणां खेहजातीयानाम्

एकः परिचयः जलपरमाणुः तेषां च महाजलादिः, एवं गन्धरसौ ब्रह्मयित्वा  
 शीघ्राणातीयाणां त्रितन्मात्राणां त्रितीऽणुः तैभ्यः महातेजःआदिः । एवं  
 गन्धरसकृपाणां वर्ज्यतात् द्वाभ्यां वायुः तैभ्यः महावायादिः । एवं ब्रह्मतन्मात्रा-  
 दृष्ट्वाप्राप्तसकृतात् आकाशाणुः तैभ्यः महाकाशादिः ।

विश्वामित्र remarks :— अथ दर्शने अयं सिद्धान्तः ब्रह्मादि-  
 तन्मात्रपञ्चके प्रकृत्यैव विद्यमानः पृथिवीत्वाद्विजातयः सन्ति । ( योगवार्त्तिक, Sutra 14, Pada IV.)

Before explaining the genesis of atoms, it is necessary to say something about A'kása. which is the link between the infra-atomic particles (Tanmátras), and atoms (Paramáñus). A'kása corresponds in some respects to the ether of the physicists, and in others to what may be called proto-atom (protyle) In one aspect A'kása is all-pervasive ( विश्व ), and devoid of the property of impenetrability which characterises even the infra-atomic potential units (Tanmátras). In another aspect, A'kása is described as having originated out of the mass or inertia in Prakṛiti (Bhútádi) when the latter became charged with the first potential vibration ( the sound-potential ). Vijñána-bhikshu in the Yoga-Vártika boldly tackles the difficulty. A'kása, he explains, has two forms, original and derivative, non-atomic and atomic. The original A'kása is the undifferentiated formless Tamas (mass in Prakṛiti, matter-rudiment—Bhútádi) which is devoid of all potentials, and is merely the all-pervasive seat or vehicle of the ubiquitous original Energy ( Rajas ). This A'kása

must not be confounded with vacuum, which is merely negative (आवकाशभाव—un-occupiedness), though it must be conceived as all-pervasive, occupying the same space as the various forms of gross matter (समानदेशकम्—अवकाशरूपम् आकाशं—योगवार्तिक), and therefore devoid of the property of impenetrability (सूक्ष्मांतरासमानदेशकं—योगवार्तिक) which characterises atomic matter. But when the original equilibrium (साव्यावस्था) comes to an end, unequal aggregations form collocations in different groups and proportions of the three Gunas. (गुणानुधिक्यभावेन अन्तर्गुणसंयोगविशेषः सङ्घननं—विज्ञानभिद्यु, प्रवचनभाव्य and योगवार्तिक). The transformation of Energy now begins,—working on a collocation of mass (with Essence), (गुणान्तरीय-समृद्धं सदैवतः—विज्ञानभिद्यु, योगवार्तिक); it first gives rise to the sound potential (शब्दजननयोग्यार्थरूपेण परिचलति—विज्ञानभिद्यु) and the atomic A'kása (proto-atom, protyle) is but an integration of the original unit of mass charged with this vibration-potential. This vibratory (or rather rotary) ether-atom (आकाशाणु) is integrated, limited (परिच्छिन्न) and as such cannot occupy the same space with other (subsequently integrated) atoms. But this proto-atomic integration of A'kása (कार्याकाश) is formed everywhere, and itself residing in the ubiquitous non-atomic A'kása (कारणाकाश—अवकाशरूपमाकाशं; forms the universal medium in which air or gas atoms, light and heat corpuscles, and other atoms move and float about. (वायोरावरणं यदि हि अवकाशरूपम् आकाशं

न स्यात् तदा सूर्यद्रव्येषु स्याद्यादिषु अन्तर्लेशादिप्रवेशो न स्यात्—  
विज्ञानमिच्छु, योगवार्त्तिक Sutra 40, Pada III. आकाशं हि  
कार्यकारणरूपेण द्विविधम् । तत्र कारणाकाशं तन्मेषुचविशेषसत्त्वेन  
व्यवह्रियते । तदानीम् आकाशताव्यञ्जकशब्दादिगुणविशेषाभावात् । तत्र  
कारणाकाशं गुणानुरोसम्भवं सदैवतः आदी शब्दजननयोग्यार्यरूपेण परिचक्षते ।  
ततश्च अणुसङ्घातेन पृथिवीवदेव महाभूताकाशम् अहङ्कारापेक्षया परिच्छिन्नं  
वायोरावरणम् उच्यते (विज्ञानमिच्छु, योगवार्त्तिक, Sutra 40, Pada III.)

*The genesis of the infra-atomic unit-potentials  
(Tanmátras) and of the atoms.*

The subject of the genesis and the structure of the Tanmátras and the Parámánus was a fascinating one to these ancient thinkers, and a wide divergence of views prevailed. I will here notice several typical views :—those of the Vishnu Purána, Parásara, Patañjali and a certain School of Vedantists reported in the तत्त्वनिर्णय.

I. A famous passage in the Vishnu Purána explains the genesis and the structure of the Tanmátras and of the Bhútas ( Parámánus ) in the following manner :—

The first Tanmátra originated from the rudiment-matter (Bhútádi), the individuated but still indeterminate potential-less Mass in Prakṛiti, under the action of Energy ( उपपन्नतः परिणमयन्ति—प्रवचनभाष्य, Sutra 62, Ch. I.) by a process of disintegration and emanation ( विकर्षणः—विष्णुपुराण—एकविकारारम्भः—व्यासभाष्य, Sutra 14, Pada IV. विकारवभावः विकीर्णतास्वभावः व्यापिता इति

यावत्, योमनासिञ्ज on *Patañjali's Sutra*.—मनोजविलं विकरणभावः etc.) in the menstruum, or surrounding medium of the unindividuated 'Cosmic Mass (Mahat) (महतावतः).

This first subtile matter, the first result of 'Mass-disintegration' and Energy-transformation, is charged with the sound-potential, the potential of vibration or oscillation (परिचयः). It is called the sound-potential (शब्दतन्मात्र).

This is typical of the genesis (and structure) of the other Tanmātras (kinds of subtile matter). In each of the remaining cases, an atomic Mass charged with actual specific energies (भूतपरमाणु) disintegrates and emanates, and thus evolves a form of subtile matter (a kind of Tanmātra) under the action of Energy, and always in the same menstruum or surrounding medium,—that of Bhūtādi, the super-subtile. Each kind of subtile matter becomes charged with a new potential in addition to the potentials already evolved. The genesis of an atom, a Bhūta-Paramāṇu, is a quite different process. Here the unit potential (Tanmātra) receives an accretion of Mass, and by a sort of condensation and collocation evolves an atom (Bhūta-Paramāṇu).

The genesis and structure of the Tanmātras and the Bhūta-Paramāṇus are worked out below :—

1. The super-subtile individuated Mass (rudiment-matter (Bhūtādi), under the action of the

original Energy (रजः) disintegrates and emanates (विकसते) in the menstruum or surrounding medium (समावरण) of Mahat, cosmic super-subtile Mass, and evolves a form of subtile matter (तन्मात्र), which becomes charged with the sound-potential (vibration-potential, परिच्यन्द), and is called the unit of sound-potential (शब्दतन्मात्र).

2. This subtile matter, the Mass, charged with sound-potential, receives an accretion of Mass from the rudiment matter (Bhútádi) and by condensation and collocation evolves the Ākāśa Bhúta, the atomic A'káśa, the proto-atom charged with the specific energy of the sound stimulus (actual vibratory motion.) (स एव भूतादिः शब्द-तन्मात्रात् खड्गितयात् शब्दगुणकम् आकाशं ससर्जम् । तथाच अहङ्कारशब्दतन्मात्राभ्यां मिलित्वा आकाशं स्रज्यते,—योगवार्त्तिक or the Vishnu Purána's passage, Sutra 14, Pada IV).

3. This proto-atom, the atomic A'káśa, charged with its actual specific energy, again disintegrates and emanates, under the action of the original Energy, and in the menstruum of the rudiment-matter (super-subtile Mass) and thus evolves another kind of subtile matter (Tanmátra) which becomes charged with the touch potential (the potential of impact or mechanical pressure

( प्रवर्धित, बृहन्महील्ल ) in addition to the sound-potential ( vibration-potential—परिचय ) and is called the unit of touch-potential ( स्पर्शतन्मात्र ) .

4. Next, this subtile matter, the mass charged with touch ( and sound ) potential, *i.e.* with the potentials of vibration and impact, receives an accretion of mass again from the rudiment-matter (Bhútádi) and by condensation and collocation, evolves the Váyu Bhúta, a kind of gaseous matter or air of which the atoms are charged with the actual specific energy of the touch stimulus, *i.e.* with actual energy of impact in addition to the actual energy of vibratory motion.
5. Next, the atom of Váyu, so charged with the actual specific energy of impact and vibration, again disintegrates and emanates, under the action of the original Energy, and in the same menstruum or surrounding medium of the rudiment matter ( super-subtile Mass—Bhútádi) and thus evolves another kind of subtile matter (Tanmátra), which becomes charged with the heat-potential ( शीष्ण—उष्ण—heat-and-light-potential) in addition to the impact-potential and the vibration-potential, and is called the unit of colour-potential ( रसतन्मात्र ) .

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6. Now this subtile matter, this radiant matter, charged with light-and-heat potential, and also with impact and vibration potential, receives an accretion of Mass again from the rudiment-matter (Bhútādī), and by condensation and collocation evolves the Tejas Bhúta, the light-and-heat-corpuscle, which is charged with the specific Energy of the colour-stimulus, *i.e.* radiates actual heat and light (विकिरण) in addition to manifesting the energy of impact (impingency) and of vibration (or oscillation).
  7. Next, this atom or light-and heat-corpuscle disintegrates, and emanates as before a form of subtile matter charged with the taste potential (रसवन्मात्र), in addition to the three potentials already generated, and also with the physical potential of viscous attraction.
  8. This subtile matter charged with the taste-potential and with the potential of viscous attraction condenses and collocates as before into the water-atom which manifests the actual specific energies of viscous attraction and the taste-stimulus.
  9. The viscous water-atom charged with the actual specific Energy of the taste-stimulus disintegrates, and emanates as before a form of subtile matter charged with the

smell-potential in addition to the four potentials already generated and also with the potential of cohesive attraction.

10. This subtile matter charged with the smell-potential and with the potential of cohesive attraction condenses and collocates as before into the earth-atom, which manifests the actual specific Energies of cohesive attraction and the smell-stimulus

Vijñána-bhikshu in the *Yoga-Vártika* briefly summarises the *Vishnu Purána* process as follows : --

Bhútádi as radicle in conjunction with Mahat produces the sound potential which as radicle in conjunction with Bhútádi produces Ákása, which as radicle in conjunction with Bhútádi produces the touch-potential, which as radicle in conjunction with Bhútádi produces Váyu, which as radicle in conjunction with Bhútádi produces the colour-potential, which as radicle in conjunction with Bhútádi produces Tejas and so on.

In this brief summary he does not bring out the force of विकर्षणः (the disintegrating process), and the distinction between the genesis of subtile and gross matter (Tanmátra and Bhúta).

यथा प्रधानेन महान्, महता स तथाहतः ।

सूतादिस्तु विकर्षणः सर्गं तन्मात्रिकं ततः ।

ससर्जं शब्दतन्मात्रात् आकाशं शब्दलक्षणा ।

शब्दमात्रं तदाकाशं भूतादिः स समावृणोत् ।

आकाशस्तु विकृष्टीयः स्पर्शमात्रं ससर्जं ह ।

बलवान् अभवत् वायुः तस्य स्पर्शो गुणो मतः । (विष्णुपुराण)

II. A famous passage in Parásara takes another view of the genesis and structure of the Tanmātras and the Bhūta-Paramānus. Krishṇa-pāda. in the तत्त्वत्रयविवरण, represents the scheme as follows :—

The Tanmātras originate from one another in one linear series, and each Bhūta originates in a separate line from its own Tanmātra :—

भूतादि (Bhūtādi)

शब्दतन्मात्रं Sound-Tanmātra—as a radicle or centre surrounded or encircled by Bhūtādi generates A'kāsa.

स्पर्शतन्मात्रं Touch-Tanmātra—as a radicle or centre encircled by Sound-Tanmātra with A'kāsa-atom as a help generates Vāyu—

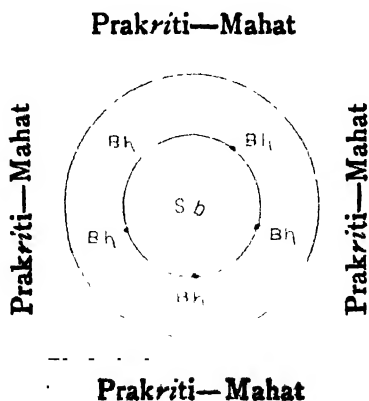
रूपतन्मात्रं Colour-Tanmātra—as a radicle or centre encircled by Touch-Tanmātra with Vāyu-atom as a help generates Tejas—

रसतन्मात्रं Taste-Tanmātra—as a radicle or centre encircled by Colour-Tanmātra with Tejas-atom as a help generates Ap—

गन्धतन्मात्रं Smell-Tanmātra—as a radicle or centre encircled by Taste-Tanmātra with Ap-atom as a help generates Pṛthivi.

The genesis of a Bhúta-Paramánu (atom) from the subtile matter of a Tanmátra is not here so simple as in the view of the Vishnu Purána. The latter speaks of condensation and collocation, but in the passage under reference a Tanmátra is supposed to act as a radicle, as the centre of a system, surrounded or encircled by Tanmátras of the immediately higher order in the medium of its own Bhúta.

Thus an atom of A'kása has the following structure :—

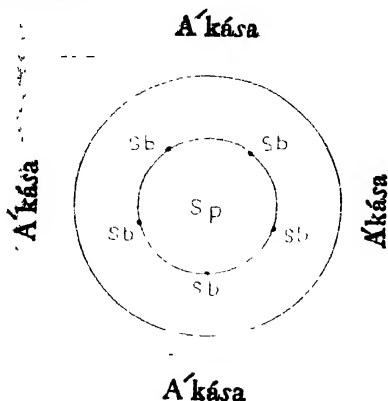


An atom of A'kása

Sb = Śabda-Tanmátra (vibration-potential)  
 Bh = ( Bhúta )

An atom of Váyu is constituted as follows —

This takes place within the surrounding medium of A'káśa.

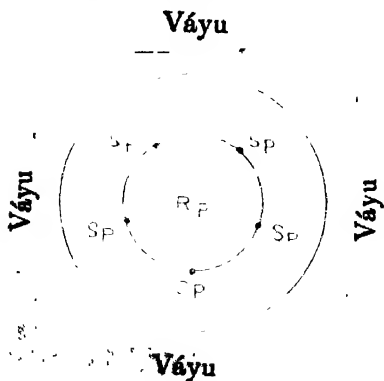


An atom of Váyu

Sp=Sparsa-Tanmátra (impact-potential)

Sb=S'abda-Tanmátra (vibration-potential)

An atom of Tejas—heat-and-light corpuscle—has the following structure :—



An atom of Tejas

Rp = Rúpa-Tanmátra (light-potential)

Sp = Sparsa-Tanmátra (impact-potential)

and so on.

A Chemist will be disposed to push his chemical processes into the region of subtile matter. He may translate आवरण as a menstruum, and सहायक as a catalytic agent. In this case, an atom of Váyu will be considered as generated from the impact-Tanmátra as a radicle, in the menstruum of vibration-Tanmátra, with A'kása-atoms as a catalytic agent.

अथायं क्रमः—भूतादिः शब्दतन्मात्रं जायते, शब्दतन्मात्रं स्पर्शतन्मात्रं जायते, ततः आकाशं जायते, ततः अस्मात् शब्दतन्मात्रात् स्पर्शतन्मात्रं जायते, स्पर्शतन्मात्रं शब्दतन्मात्रमावरोहतीति, एवं शब्दतन्मात्रावरोहतात् आकाशसहायकात् स्पर्शतन्मात्रात् वायुर्जायते, ततः अस्मात् स्पर्शतन्मात्रात् रूपतन्मात्रं जायते, रूपतन्मात्रं स्पर्शतन्मात्रमावरोहतीति, एवं स्पर्शतन्मात्रावरोहतात् वायुसहायकात् रूपतन्मात्रात् तेजो जायते—and so on. अयं क्रमः तत्त्वत्रयविवरणे ज्ञानपादैस्ततः । परपरसुनि, तत्त्वत्रयभाष्य (अचिन्मकरण).

A slight variation of the above view is ascribed to a certain school of Vedantists in the तत्त्वनिर्ूपण.

The scheme may be represented as follows :—

A Bhúta-atom is evolved by integration (condensation and collocation, सूत्रावस्थापन) from the corresponding Tanmátra (subtile matter). This is the same view as that of the Vishnu purána.

The Tanmātras again evolve from one another in a lineal series as in Parásara's view. But the process of this generation is somewhat more complex. A Tanmātra first disintegrates and emanates in a surrounding medium (a menstruum) of the Tanmātra just preceding it in the order of genesis and with the help of its own Sthúla Bhúta as a sort of catalytic, generates the Tanmātra next in order; *e.g.*, the infra-atomic impact particles (सूक्ष्मकण) disintegrate or emanate, in a surrounding 'atmosphere' of the vibratory subtile matter (सूक्ष्ममात्र) and then with the help of their own atomic integration Vāyu, gas, generate the Tanmātra next in order, the subtile matter of radiant light-and-heat (तेजः).

III. Patañjali's view, as expounded in the व्यास-भाष्य and योगवासिष्ठ is as follows :—

(a) The order of genesis of various forms of subtile matter (potentials):—

(1) Bhútádi, the rudiment-matter, original Mass, acted on by Rajas, Energy, produces the sound-potential ( vibration-potential ) अन्वा-  
न्वाभ्याम् अहङ्काराभ्यां सकार्त्तजनने राजवाहङ्कारः  
अहङ्कारीभवति ।

(2) This subtile vibration-potential, as a radi-  
cle, with accretion of rudiment-matter

(Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtle touch-potential (impact-potential) which is impingent as well as vibratory (oscillating).

- (3) This subtle impact-potential again, as a radicle, with accretion of rudiment-matter (Bhútádi) condensing and collocating, and acted on by Rajas, generates the subtle light-and-heat potential ( रूपमन्मात्र ) which radiates light-and-heat, in addition to being impingent and vibratory.
- (4) Next, the light-and-heat potential, as a radicle, with accretion of rudiment-matter, (Bhútádi) condensing and collocating as before, generates the subtle taste-potential, which is charged with the potential of the taste-energy, and of viscous attraction, in addition to being vibratory, impingent and radiant.
- (5) Lastly, the subtle taste-potential as a radicle, with accretion of rudiment-matter as before, condensing and collocating, generates the subtle smell-potential, which is charged with the potential of the smell-energy, and also of cohesive attraction, in addition to being vibratory, impingent and radiant.

The order of genesis of the Bhúta Paramánuś, (forms of atomic matter).

The five classes of atoms are generated as follows :—

- (1) The sound-potential, subtile matter, with accretion of rudiment-matter ( Bhútádi ) generates the A'kása-atom
- (2) The touch-potentials combine with the vibratory particles ( sound potential ) to generate the Váyu-atom.
- (3) The light-and-heat potentials combine with touch-potentials and sound-potentials (*i.e.* with impact particles and vibratory particles) to produce the Tejas-atom.
- (4) The taste-potentials combine with light-and-heat potentials, touch-potentials and sound-potentials (*i.e.* with radiant, impingent and vibratory particles) to generate the Ap-atom and
- (5) The smell-potentials combine with the preceding potentials (*i.e.* with particles of touch-energy and with radiant, impingent and vibratory particles) to generate the earth-atom.

The A'kása-atom possesses penetrability, the Váyu-atom impact or mechanical pressure, the Tejas-atom, radiant heat-and-light, the Ap-atom, viscous attraction, and the Earth-atom, cohesive attraction.

Vijñāna-bhikshu in one passage gives the following scheme of the genesis of the Bhútas :—

A radicle of sound-potential with rudiment-matter gives A'kása-atom (Bhútádi), a radicle of touch-potential with A'kása-atom gives Váyu-atom, a radicle of light-and-heat potential with Váyu-atom gives Tejas-atom, a radicle of taste-potential with Tejas-atom gives Ap-atom, and a radicle of smell-potential with Ap-atom gives Earth-atom. On this view, an atom

of A'kása = Bh(Sb)

of Váyu = { Bh(Sb) } (Sp)

of Tejas = { Bh(Sb) } (Sp) Rp

where Bh = भूतादि, Sb = शब्दतन्मात्र, Sp = स्पर्शतन्मात्र, Rp = रूपतन्मात्र, and so on.

Bhútas and Paramānus—Cosmo-genesis and its successive stages.

The 'five Bhútas' stand for a classification of substances on the basis of their generic properties resulting, as the Sāṅkhyas hold, from the structural type of their constituent atoms—a classification more physical than chemical, or properly speaking chemico-physical, unlike the purely chemical classification of the so-called elements of modern chemistry. A Paramānu, again, is a type of atoms corresponding to each Bhúta class, and indeed one and the same kind of Paramānu may

comprehend atoms of different masses, if only these should agree in their structural type.

**Cosmo-genesis**—a bird's eye view:—Out of the all-pervasive rudiment-matter (Bhútádi) appeared A'kása (ether), first as a Tanmátra (subtile matter) charged with the potential energy of sound (vibration-potential), and then as an atomic integration of a mono-Tanmátric structure (the A'kása-atom —आकाशाणु) also ubiquitous and all-enveloping. In the next stage we find a new kind of Tanmátras, systems of the infra-atomic vibratory particles, so arranged as to manifest a new form of energy, that of impact or mechanical pressure and these Tanmátras (सर्पनन्मात्राणि) combining with the vibration-potentials (A'kása Tanmátra) produced a new kind of atom, the di-Tanmátric Váyu-atom, which by aggregation formed a gaseous envelope composed of impinging (driving) vibratory particles (Váyu). Next appeared the third class of Tanmátras, infra-atomic systems of the impinging vibratory particles, which by their collocation developed a new form of Energy—the energy of radiant heat-and-light. These Tanmátras (हयनन्मात्राणि) combining with the potentials (Tanmátras) of vibration and impact, produced a new kind of atom—the tri-Tanmátric Tejas-atom, the light-and-heat corpuscle, which by aggregation enveloped the gaseous world in huge flames. In the next stage we have the fourth class of

Tanmátras, new and complex infra-atomic systems of the radiant impinging vibratory particles, which evolved the energy of viscous attraction as well as the potential Energy concerned in the taste-stimulus. These Tanmátras (रसतन्मात्राणि) combining with the three previous ones, gave rise to another class of atoms, the tetra-Tanmátric Ap-atom, and the flaming gases were thus precipitated into cosmic masses of viscous fluid matters (Ap). Finally appeared the fifth class of Tanmátras infra-atomic systems of the viscous radiant impinging vibratory particles which developed new forms of Energy—the Energy of cohesive attraction, as well as the potential energy concerned in the stimulus of smell. These Tanmátras (गन्धतन्मात्राणि) uniting with the other four kinds of infra-atomic subtile particles, formed another class of atoms, the penta-Tanmátric Earth-atom. Thus the viscous fluid matters were condensed and transformed into the Earth-Bhúta, comprising the majority of the so-called elements of chemistry.

The Puráṇas, in their own fanciful way, conceive that, in the course of cosmic evolution, each succeeding Bhúta appeared within an outer envelope of its immediate predecessor, with a total mass (or volume ?) a tenth less than that of the latter.

वियत् तत्वाष्कदेशगतो वायुः प्रकल्पितः ।  
 चिन्तयेत् वह्निमप्येषं मरुतो न्यूनवर्त्तिनं ॥  
 ब्रह्माण्डावरणेष्वेषां न्यूनाधिक-विचारणा ।  
 वायोर्दशांशतो न्यूनो वह्निर्यायौ प्रकल्पितः ॥  
 पुराणीकं तारतम्यं दशांशैर्भूतपञ्चके ॥

( पञ्चदशी-भूतविवेक ) slokas 72, 81 and 82 )

Examples of the different Bhútas :—

1. A'kása. This is ubiquitous.
2. Váyu. Various substances composed of di-Tanmátric atoms,—kinds of Váyu—must have been formed in the gaseous envelope in the second stage of cosmic evolution, out of the proto-atoms of A'kása. But they have either suffered a fresh transformation into substances of a more complex atomic structure, or have dissipated into the mono-Tanmátric A'kása, out of which they took their rise. The one familiar example now surviving is atmospheric air. Water-vapour (वाष्प) is but water (Ap), and smoke, fumes, etc. but earth-particles in gaseous diffusion.
3. Tejas :—Various classes of Tejas corpuscles,—substances with tri-Tanmátric atomic structure, i.e. two grades subtler

than the ordinary elements of chemistry (which are of a penta-Tanmátric structure),—are even now known. ( तेजो भौमादि-भेदेन बहुविधं । भौमं दिव्यं औदय्य आकरजं—वरवरमुनि,—तत्त्वत्रयभाष्य ) ।

First, there is fire, or the light-and-heat emitted by the burning log of wood or lamp (अग्निः—दीपः—भौमं तेजः). Now it is important to note that the flame of a burning log of wood (इव्यन) or an oil-lamp is not pure Tejas, a pure mass of light-and-heat corpuscles. There is chemical union with Earth-particles (particles of the hard penta-Tanmátric substance) acted on by Energy; and then the Tejas corpuscles, light-and-heat particles which are latent (absorbed) therein, come forth as flame ( पार्थिवीपटन्मेन तदनुगतात् तेजसः अग्निर्भवति—विज्ञानभिद्युः—प्रवचनभाष्य, Sūtra 110, Chap. V. ) Then there is the light of the sun and the stars ( दिव्यं सौरं आदित्यादि ) which are flaming masses of molten viscous matters ( जलमावेन्धनं तेजः दिव्यं तच्च सूर्यादि,—तत्त्वत्रयभाष्य, अचित्प्रकरण ) or of molten earthy matters ( सूर्यादीनि सर्वाणि तेजांसि पार्थिवद्रव्य-सङ्गेनैव अवस्थितानि,—विज्ञानभिद्युः, प्रवचनभाष्य, Sūtra 13, Chap. III.) There is also the lightning, which liberates a kind of Tejas latent in the aqueous particles and vapours, under the action of

Energy, in the same way as an ordinary fire liberates the Tejas latent in the wood or other fuel. Next there are the stores of animal heat derived from the break-up of the nutritive material (जीवज्वर). Lastly there comes the peculiar form of the Tejas Energy (radiant Energy) stored up in the metalliferous ores and igneous rocks which have been formed in the subterranean heat. Here Earthy matters are mixed up, but the radiant Energy predominates in the composition of the metals (तेजसाधिक्येन तेजसादिना सुवर्णादीनां—विज्ञान-निष्ठ, प्रवचनभाष्य, Sūtra 19, Chap. III.) Aniruddha, a late Sāṅkhya commentator, notes in reference to 'igneous bodies' that the greater part of their mass is derived from the Earth-Bhūta, though the Tejas particles determine the peculiar chemical combination, which produces them; and this must also be his view of the composition of the metals. तत्र अपि (तेजसे प्रसीदे अपि), बहुतराया विवाहवाचक-कृतं, व्यपत्ते वाक्यभोवात्। (अनिरुद्धहसि—Sūtra 112, Chap. V.)

4. Ap. This viscous fluid of a tetra-Tanmātric structure has but one pure example, viz, water, though the various organic acids, the juices of fruits and the saps of plants, are supposed to be transformations of watery radicles combined with different kinds of earthy accretions.

5. Lastly the Earth-Bhúta, the hard full-formed matter, with its penta-Tanmátric atoms, comprises by far the majority of the so-called chemical elements.

The question is,—how does one and the same Bhúta, of the same formal structure, comprise different kinds of elements, with different atomic masses, and different characteristic properties? And the answer is not far to seek. The properties of a thing are only the energies that are manifested in the particular collocations of the three Gunas,—Mass, Energy and Essence; and a tri-Tanmátric, or a penta-Tanmátric atom, *i.e.* an atom composed of three or of five kinds of Tanmátras may differ from another of the same class, in respect of the number of constituent Tanmátras of any particular kind, as also of their collocation or grouping, and therefore in mass as well as in generic and specific characters.

The Sāṅkhya-Pātañjala conceives the properties (or energies) of substances to result from the grouping or the quanta of the Tanmátras, or the Gunas themselves, and hence any radical differences in substances of the same Bhúta class must characterise their atoms, though in an insensible form. In the Nyāya-Vaiśeṣika, on the other hand, the atoms of the same Bhúta class are alike in themselves, homogeneous; and the variety of substances comprehended under the

same Bhúta, is ascribed merely to the different arrangements or groupings of the atoms (अणु) and not of their components, for components they have none.

As a typical and familiar instance of the variety of characteristic properties (or energies) that may result from variations in accompaniment or grouping, the Sāṅkhya-Pātañjala points to the various kinds of fruit acids and juices, all originating from one and the same Bhúta (water) with different accretions of earthy matters (भूविकाराः). In the same way, though we speak of only five classes of Tanmātras and atoms, the infinite variety of the world results from the infinitely varied collocations of the three original Gunas, which underlie Tanmātra and atom alike (सत्त्वरजस्तमसां अपकर्षकाद्यापन्नः संघातः परमाणुरिति—न्यायवार्त्तिक, उद्योतकर, reporting the Sāṅkhya view : अणुसिद्धावयवः संघातः परमाणुरिति—व्यासभाष्य, Sūtra 44, Pada III.—परमाणुः सामान्याविशेषात्मकः अणुसिद्धावयवभेदानुगतः सप्तुदायः—व्यासभाष्य, Sūtra 44, Pada IV,—योगप्रज्ञापञ्चिका धर्म्मिणः शक्तिरेव धम्माः (ibid, Sūtra 14, Pada III.) यो धर्म्मेण अणुधातो सामान्य-विशेषात्मा सोऽन्वयी धर्म्मी (ibid, Sūtra 14, Pada III. )

व्याख्यानम्—कथं एकरूपाणां रसानां अनेकरूपा प्रवृत्तिः—इत्यत आह परिणामतः सन्निरूपणम् । यथा नारिद्विमुक्तं उदकं एकरसं सपि कस्तूर-विकारात् आकाश नारिदेव-तापी-वित्त-

चिरदिव्य-निन्दुकामलक-कपित्थ फलरसतवा परिणामात् सधुरा-  
 श्वसवणनिक्त कटुकपायतवा विकल्पते, एवमेकैकरुण्यसन्धवात् प्रधानं  
 गुणं आश्रित्य अप्रधानगुणाः परिणामभेदान् प्रवर्तयन्ति ।  
 तदिदमुक्तं प्रतिप्रति गुणान्वयविशेषात्, एकैकरुण्यान्वयेण वो  
 विशेषस्तस्मात् इत्यर्थः ।

( वाचस्पति—कौमुदी—On Kārikā 16. )

If we take a unit of rudiment-matter (Bhútādi) for the unit of mass (cf. the mass of an electron with a charge of motion etc.), and represent the first Tanmātra by  $t_1$  such units, and if further,  $t_2, t_3, t_4, t_5$  units of mass (Bhútādi) be successively added at each accretion to form a fresh Tanmātra, then the second, third, fourth and fifth Tanmātras will respectively contain  $t_1 + t_2, t_1 + t_2 + t_3, t_1 + t_2 + t_3 + t_4$ , and  $t_1 + t_2 + t_3 + t_4 + t_5$  units of mass.

Also the Vāyu atom (bi-Tanmātric system) will contain  $t_1 + (t_1 + t_2)$ , i.e.  $2t_1 + t_2$  units of mass ; the Tejas-atom (tri-Tanmātric system) will contain  $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3)$  i.e.  $3t_1 + 2t_2 + t_3$  units ; the Ap-atom (tetra-Tanmātric system)  $t_1 + (t_1 + t_2) + (t_1 + t_2 + t_3) + (t_1 + t_2 + t_3 + t_4)$ , i.e.  $4t_1 + 3t_2 + 2t_3 + t_4$  units ; and the Earth-atom (penta-Tanmātric system),  $t_1 + (t_1 + t_2) + \dots + (t_1 + t_2 + t_3 + t_4 + t_5)$ , i.e.  $5t_1 + 4t_2 + 3t_3 + 2t_4 + t_5$  units.

If  $t$  units of mass be added to the first Tanmātra to form the atom of Ākāśa, the latter will contain  $t_1 + t$  units of mass.

In other words the numbers representing the mass-units ( Tamas ) in the different classes of atoms ( gross matter ) will form an ascending series, viz,  $t_1+t_2$ ,  $2t_1+t_2$ ,  $3t_1+2t_2+t_3$ ,  $4t_1+3t_2+2t_3+t_4$ , and  $5t_1+4t_2+3t_3+2t_4+t_5$ .

Now if a follower of the Sāṅkhya-Pātañjala were asked to account for differences among Paramāṇus of the same Bhūta class, he would perhaps suppose  $t_1$  to vary from  $\alpha_1$  to  $\beta_1$ ,  $t_2$  from  $\alpha_2$  to  $\beta_2$ ,  $t_3$  from  $\alpha_3$  to  $\beta_3$ ,  $t_4$  from  $\alpha_4$  to  $\beta_4$ , and  $t_5$  from  $\alpha_5$  to  $\beta_5$ .

Therefore the mass-units contained in the Vāyu-atoms of the different possible Vāyu substances would be represented by  $2\alpha_1+t$ ,  $2\alpha_1+1+t$ ,  $2\alpha_1+2+t$ , .. .....  $2\beta_1+t$ , in A. P. with unity as common difference, there being  $2(\beta_1-\alpha_1)+1$  possible Vāyu substances.

The mass-units contained in the Tejas-atoms of the different possible Tejas substances would be represented by the series,  $3\alpha_1+2\alpha_2+\alpha_3$ ,  $3\alpha_1+2\alpha_2+\alpha_3+1$ , .....  $3\beta_1+2\beta_2+\beta_3$ , increasing in A. P. by unity as common difference, then being  $3(\beta_1-\alpha_1)+2(\beta_2-\alpha_2)+(\beta_3-\alpha_3)+1$ , Tejas substances possible.

The mass-units contained in the Ap-atoms of the different possible Ap-substances would form the series  $4\alpha_1+3\alpha_2+2\alpha_3+\alpha_4$ ,  $4\alpha_1+3\alpha_2+2\alpha_3+\alpha_4+1$ , .....  $4\beta_1+3\beta_2+2\beta_3+\beta_4$ , there being  $4(\beta_1-\alpha_1)+3(\beta_2-\alpha_2)+2(\beta_3-\alpha_3)+(\beta_4-\alpha_4)+1$  Ap-substances possible.

The mass units contained in the Earth-atoms of the different possible Earth-substances would form the series in A. P.,  $5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5$ ,  $5\alpha_1 + 4\alpha_2 + 3\alpha_3 + 2\alpha_4 + \alpha_5 + 1, \dots, 5\beta_1 + 4\beta_2 + 3\beta_3 + 2\beta_4 + \beta_5$ , there being  $5(\beta_1 - \alpha_1) + 4(\beta_2 - \alpha_2) + 3(\beta_3 - \alpha_3) + 2(\beta_4 - \alpha_4) + (\beta_5 - \alpha_5) + 1$  Earth-substances possible.

Size (परिमाण).—As to size or volume, the Sāṅkhya accepts only two kinds,—the infinitesimal, which is also without parts (अणु—निरवयव) and the non-infinitesimal, which consists of parts (बहुत—वायव्य). The latter varies from the excessively small (the so-called Anus, Tanmātras and Paramānus) to the indefinitely great (परमबहुत—विष्णु,—e.g.—Ākāśa).

The Gunas alone are infinitesimal, with the exception of those ubiquitous ones that evolve into Ākāśa-atoms and Mind-stuff (आकाशाणु, and मनःकरण):—all the rest of the evolved products (whether subtle or gross matter) are non-infinitesimal.

Vijñānabhikṣu notes that all the Gunas (Reals) cannot be ubiquitous. If this were the case, that disturbance of equilibrium, that unequal aggregation with unequal stress and strain, with which cosmic evolution begins, would be impossible. The Gunas, which give rise to Ākāśa and Mind-stuff, must be held to be ubiquitous, and this will suffice for the ubiquity of Prakṛiti.

( न च अकार्थक्येण गुणाख्यप्रकृतेः विभुत्वमेवावगम्यते इति वाच्यम् ।  
अतः अकार्थक्यमहे, गुणानां विभुत्वेन तदुपपत्तेः । सर्वगुणानां  
विभुत्वे इति अकार्थक्यात्प्रकृत्ये, जोनसंयोगाद्यसंभवात् ( जोग-  
वार्त्तिङ्ग, Sūtra 51, Pada III. )

**Chemical analysis and Synthesis—Elements and Compounds.**

What then is the equivalent in the Sāṅkhya-Pātañjala of the distinction between a chemical element and a chemical compound, or is there none? Did or did not this elaborate physical analysis and classification of things lead on to a classification based on chemical analysis and chemical synthesis? These are questions of singular interest, the answer to which will disclose some new points of view from which the ancient Hindu thinkers approached the problems of chemical physics and physical chemistry.

**Aggregates (सङ्गृहाः)** may, in regard to their structure, be divided into two classes, (1) those of which the parts are in intimate union and fusion, being lost in the whole (अव्युत्तसिद्धावयवाः सङ्गृहाः); and (2) mechanical aggregates, or collocations of distinct and independent parts (व्यवसिद्धावयवाः सङ्गृहाः).

A substance is an aggregate of the former kind, and may be divided into two classes, (1) the Bhūtas and their 'isomeric' modifications (भूत, भूतभेद and भूतविकार); and (2) chemical compounds (निमित्तद्रव्य).

संज्ञकपूर्वार्थ). Chemical compounds again may be subdivided into two classes, (1) those composed of atoms of the same Bhūta class, i.e. of different isomeric modifications of the same Bhūta, and (2) those composed of atoms of different Bhūta classes. In the first case, there is contact between 'isomeric' atoms (सजातीय-संबन्ध), in the second case between heterogeneous or 'polymeric' atoms (विजातीय-संबन्ध). The first contact leads to intimate union (सङ्गः,—सङ्गादयः यः संबन्धविशेषः तेनैव द्रव्याणां विकारो भवति—विज्ञानप्रियुः प्रवचनश्रवणः): the isomeric atoms by a peculiar liberation of Energy (सजातीयोपपत्त्यु—the action of similars on similars) are attracted towards one another, and being riveted as it were, form the so-called material cause (उपादान कारण) of the compound product. The second kind of contact (that between unlike or 'polymeric' atoms of heterogeneous Bhūtas) begins with a liberation of Energy (उपपत्त्यु), which breaks up each of the Bhūtas, and taking particles (or atoms) of one as nuclei or radicles groups particles of the rest round these radicles in a comparatively free or unattached condition. In this case, one Bhūta, that which serves to furnish the radicles, not necessarily that which is numerically or quantitatively predominant, gets the name of material cause (उपादान कारण), and the others, which by their collocation cause the liberation of Energy (उपपत्त्यु, सङ्गपत्त्यु or विपत्त्यु).

are called efficient causes ( निमित्त कारण )—एकैकैक-  
 युक्तसंज्ञान प्रधानं युक्तं चानित्यं अप्रधानरुखाः परिणाम-  
 भेदान् प्रवक्ष्यन्ति—वाचस्पति, बौध्दी on Kārikā 16. The  
 illustrations given ( viz. the Rāsas as modifications  
 of Ap, water, with Earth-accretions) show that this  
 process applies not only to the Guṇas, but also to  
 the Bhūtas. यथा आकाशादेकरसं सत्तत्त्वं घटितं वायुवायुत  
 संज्ञेयात् मिथ्यते—(गौडपाद on Kārikā 17).—तत्र जपि (तैजसे  
 प्रदीरे अपि) वस्तुतत्त्वादिवायववायुतत्त्वात्. अथपि च अनुप-  
 मोगतम् (अनिदृक् on Sūtra 112, Chap. V), आतिसाक्ष्यं ह्य  
 आकाशस्यैव तत्त्वादीनामवधाने अनेकैरपि दृष्टिभिः ए\*टा  
 ए\*कस्यैव तत्त्वादेनैवावधानं नास्ति । (विज्ञानभिषु,—प्रवचनभाष्य)

Aniruddha goes so far as to hold that both  
 'isomeric' and 'polymeric' (or 'heterogenic') com-  
 binations are real cases of constitutive contact.  
 (आणविक संयोग, e.g. मौलिकवायोर्देहात्म्यत्वं—अनिदृक्  
 on Sūtra 113, Chap. V.) But in the later Sāṅkhya-  
 Pātañjala the current teaching denied this -  
 वक्ष्यामि यदानीमाणात् (Sūtra 102, Chap V), when विज्ञान-  
 भिषु notes—वक्ष्यामि भिन्नजातीयानां योपादानत्वं न दृष्टमिति  
 अत्रात्रोक्तम् । इतरेषु भूतवस्तुष्वनुपपन्नमवधानम् ।

But besides these transformations of substance  
 ( द्रव्यान्तर-परिवर्तन ) by 'isomeric' or 'heterogenic'  
 process, ceaseless changes go on in the characters,  
 the modality, and the states of substances—changes

which are due to the unequal distribution of force (or of stress and strain,—pressure) among the Gunas, which are in themselves constant. (वचस्पति-व्याख्यानसंग्रहादिप्रमाणैः न दुष्मान्तरतः—यथा एका एका घन-स्थाने घनं दशस्थाने दश, एकद्वैवस्थाने, यथा वैकल्येऽपि स्त्री नाम्ना बोध्यते इतिहासः न खलु चेति,—सुचिनिबन्धनेऽपि गुणानां विनर्दने विनिरात्—व्याख्यानम्, Sūtra 13, Pada III).

“Even as the same figure ‘1’ stands for a hundred in the place of hundred, for ten in the place of ten, and for a unit in the place of unit.”\*

\* This conclusively proves that the decimal notation was familiar to the Hindus when the Vyāsa-Bhāṣya was written, i.e. centuries before the first appearance of the notation in the writings of the Arabs or the Greco-Syrian intermediaries. Vāchaspati, who comments on the Vyāsa-Bhāṣya, composed his Nyāya-Sūcī-Nibandha in वसुधवसुवत्सरे i.e. Samvat 898 or 842 A. D. This cannot be Śāka 898, for apart from the decisive use of वत्सहर, which by this time had come to signify the Samvat era, Vāchaspati’s commentator, Udayana, wrote the Lakṣhaṇāvalī in Śāka 906—

तर्कान्वराद्धनमितेव्यवहारे, यथासतः ।

वत्सहस्रवत्सरे सुबोधं वचस्पतिं ।

and Udayana, who wrote the Parisuddhi on the Tātparyya-tīkā of Vāchaspati, could not have been a contemporary of the latter, as will also appear from the invocation to Sarasvatī in the opening lines of the Parisuddhi. Vāchaspati then preceded Udayana by 142 years, and must have been himself preceded by the author of the Vyāsa-Bhāṣya by a

Now the question is,—in these mixed substances does the fusion take place by Paramānu, or by larger masses (or lumps) ? Now a Paramānu is defined to be the smallest portion of any substance which exhibits the characteristic qualities of that substance,—in other words, it stands for the smallest homogeneous portion of any substance. It is not without parts and therefore not indivisible. It is subject to disintegration. In a Bhūta or its isomeric modification, the Paramānu, the smallest homogeneous component particle, is unmixed, and therefore corresponds to the atom of modern chemistry. In a mixed substance (मिश्रितद्रव्य, संकृतवस्तुतर्ह्य) whether it is an 'isomeric' or a 'polymeric' compound, the qualities are due to the mixture, and therefore its Paramānu, the smallest homogeneous particle possessing its characteristic qualities, must result from the mixture of the Paramānus (in smaller or larger numbers as the case may be) of the component substances. The Para-

longer interval still, for Vāchaspati ascribes the Bhāṣhya to Veda-Vyāsa himself ( वेदव्यासेन भाषिते भाष्ये व्याख्या विधास्यते ). The internal evidence also points to the conclusion that the Bhāṣhya cannot have been composed later than the sixth century,—cf. the quotations from Pañchasikha, Vārshaganya, and the Shāsthī-Tāntra-Sāstra, without a single reference to Īśvara-Krishna—which is decisive. I may add that I remember to have come across passages of a similar import in Buddhist and other writings of a still earlier date.

mānu of a mixed substance therefore corresponds to what we now call molecule. (अपकर्षपञ्चमं द्रव्यं परमाणुरिति—व्यासभाष्य । सोऽस्य हि प्रविभज्यमानस्य वक्षि-  
 न्नववे अवयवत्वतारतम्यं व्यतिष्ठते सः अपकर्षपञ्चमं न परमाणुः—  
 वाचस्पति—तत्त्ववैशारदी—Sūtra 52, Pada III.—मातु-  
 नित्यता न निर्भागतं । एवमपि परमाणुः जलपरमाणु रिखादि-  
 व्यवहारस्तु एविव्यादीनां अपकर्षकाभाभिप्रायेणैव । विज्ञान-  
 भिन्नः,—प्रवचनभाष्य, Sūtra 88, Chap. V. )—That the  
 Paramānus form molecules (द्वयणुक) in forming  
 substances, is acknowledged by the Sāṅkhyas as will  
 appear from Gaudapāda,—तथा अन्योन्यात्रयाश्च द्वयणु-  
 कवत्तुणाः । (गौडपाद, on Kārikā 12). Even the Vaise-  
 shikās, with their prejudice against 'polymeric' or  
 'heterogenic' combination, acknowledge that in  
 'polymeric' compounds the different Bhūta-  
 substances unite by their Paramānus (or atoms),  
 though they rigidly insist that in such cases only  
 one atom should be regarded as the 'radicle'  
 (उदाहान or द्रव्यात्मक कारण) and the others as  
 co-efficient causes (निमित्त कारण—उपदन्तक, e.g. प्रयत्न-  
 पाद—एवं समुत्पन्नेषु चतुर्षु महाभूतेषु, महेश्वरस्याभिध्यानमा-  
 त्मान् नैजसेभ्योऽणुभ्यः पार्थिवपरमाणुसहितेभ्यो महदणुमुत्-  
 पद्यते (प्रयत्नपादभाष्य—where Śrīdhara notes पार्थिवा  
 अवयवा उपदन्तकाः and Udayana नैजज्ञानां परमाणूनां  
 पार्थिवाणुसाहित्येन अणुस्य हिरण्यत्वं विवक्षितं) ।

It is only in the mediæval Sāṅkhya-Pātañjala that under the influence of the Nyāya-Vaiśeṣika doctrine a radical difference was conceived to exist between the structure (or constitution) of a molecule composed of 'isomeric' atoms, and that of one composed of heterogeneous (or "polymeric") atoms. In the former case, there was believed to take place intimate union (सङ्ग), in the latter case, only a grouping of comparatively free or loosely attached atoms round a radicle atom (अणु), with liberation of Energy (उपद्रव्य,—उद्गर्भ—or विद्रव्य) and the setting up of unequal stress and strain (गुणवैषम्यविमर्ह—ईश्वरद्रव्य). At the same time, it was of course admitted that this distinction does not apply to the forms of subtile matter (Tanmātra—सूक्ष्मद्रव्य) which could unite in intimate fusion, whether homogeneous or heterogeneous. For example, the subtile body (सूक्ष्मशरीर) which is supposed to be the seat or vehicle of the conscious principle is acknowledged by Vijñāna-bhikṣhu to be penta-Bhautic (पञ्चभूतात्मक); in other words, all the five Tanmātras serve as material causes, though the gross body (the animal organism) is stated to be only a "polymeric" compound with the Earth-Bhūta as radicle or base. अधिष्ठानशरीरं च सूक्ष्मं पञ्चभूतात्मकं भवति । तन्मात्राणां च तत् भूतमणुः विज्ञाधिष्ठानशरीरम् (प्रवचनभाष्य—Sūtras 11

and 12, Chap. III.—प्राविद्विषयं ज्ञानानि च  
ज्ञानानि उपपन्नानि (*ibid.* Sūtra 19, Chap. III.)

But in the original Sāṅkhya-Pātañjala it appears that the production of a new substance by mixture of unlike Bhūtas ( विजातीयसंयोग ) was conceded as freely as in the Vedānta, and was conceived as nowise differing from the formation of a compound of atoms of the same Bhūta class. The Sāṅkhya analysis of all change into transformations of Energy due to collocations of unchanging Guṇas, in other words the prevailing chemico-physical ( or physical ) point of view, naturally recognises no distinction between collocations of 'isomeric' and those of heterogeneous ( or 'polymeric' ) atoms. At bottom they are all collocations of the Guṇas. Even Vījñāna-bhikṣu who, as one of the latest expounders of the Sāṅkhya-Pātañjala, has been most affected by the Vaiśeṣhika prejudice against 'polymeric' combination ( विजातीयसंयोग ) urges that the qualities of a compound substance are not necessarily the result of similar qualities in the component elements. ( सजातीय-कारणसंयोग-कारणसुधारणकता इति तु तेषां (तार्क्षिकाणां) अपि न निवृत्तः । ) Elsewhere he explains that far from the vital activity being independent it is originated and maintained by the combined operation or fusion of the different sensory and motor reflexes of the living

organism, and notes that the united operation of mixed (or miscellaneous) causes, where there is a fit collocation of matter, offers no difficulty to a follower of the Sāṅkhya-Pātañjala :—(जातिवाचकं य  
अव्यापनदोषत्वात्, सामयोनमवधाने सति अन्यैकैरपि इन्द्रियैः  
एकदा एवैकस्मिन्पदमेवाधकं नास्ति—प्रवचनभाष्य, Sūtra  
32, Chap. II.) In the middle of the ninth century, we find Vāchaspati instancing some 'heterogenic' or 'polymeric' compositions as typical examples of evolutionary change (परिणाम) and unhesitatingly accepting the substantive character of the products. In the Kaumudī he describes the various acids and juices of fruits as modifications of the same original water in the presence of different kinds of earthy accretions. The process is peculiar. The water-particle (or atom) serves as a radicle or centre of a system, and the different kinds of the Earth-Bhūta centering round this as a nucleus become the seat of forces, which bring in the development of new energies (and new qualities, *e.g.* tastes) in the water. (यथा वारिद्विमुक्तं उदकं एकरसमपि तत्तद्-  
भूतविकारान् आसाद्य नारिहेन-तापी-पिल-कपित्वादि-रसतया  
परिणामान् अधुनामुखवर्णनिष्पन्नकटुकषायतया विकल्पते । इति  
एकैकगुणसम्भवान् प्रधानगुणं आवृत्तव्यं अग्रधानगुणाः परि-  
णामभेदान् प्रवर्त्तयन्ति । (कौमुदी on Kārikā 16). Vāchaspati also points out that different substances may be transformed into one and the same substance (*e.g.*

the production of salt by the cow, the horse, the buffalo and the elephant, thrown into the salt factory of Sambara in Rajputana or of the flame of a candle by the combination of wick, oil and fire.

(परिणामैकत्वं बहूनामपि एकः परिणामः इष्टः । तद्वत्त्वा गवाक्ष-महिषमातङ्गानां रुमानिचिह्नानां एकवर्णत्वजातीय-सञ्चयः परिणामः, वर्तितैलानवानां च प्रदीप इति ।—तत्त्व-वैशारदी on व्यासभाष्य, Pada IV. Sūtra 14.)

Earlier still, *i.e.*, not later than the sixth century, the Vyāsa-Bhāṣhya, noting that inorganic matter, vegetable substances and animal substances do not differ from one another essentially in respect of their potential energies and ultimate constituents, points out that various bi-Bhautic chemical compounds of water and earth substances, in the shape of saps, acids and juices, are found in plants in their different parts. (अवधूय्योः पारिणामिकं रसादि-वैचक्षण्यं स्यादरेषु इष्टम्). In other words, bi-Bhautic compounds are here placed in the same category as 'isomeric' compounds of substances of the same Bhūta class, for here the particles of both the Bhūtas are regarded as forming the matter (material cause—उपादानकारण) of the smallest homogeneous portions of the compound substances.

*N.B.*—Vāchaspati naturally interprets this to mean separate modifications of the two Bhūtas.

The view of the earlier Sāṅkhyas that atoms of different Bhūtas may chemically combine to form molecules of compound substances as much as atoms of different modes of the same Bhūta comes out clearly in Utpala's brief reference to the Sāṅkhya system in his commentary on Varāhamihira's *Vrihat Samhitā*. (एभ्यः पञ्चभ्यः [तन्मात्रेभ्यः] पञ्चमहाभूतानि संवन्ति । तेभ्यः शरीरेणां शरीराणि । यतः पञ्चमहाभूतमयानि शरीराणि (Utpala, Chap. 1, Ś'loka 7 ).

Chemistry in the medical schools of ancient India :—As a matter of fact, long before the fifth century, probably as early as the first century A. D., the prevailing schools of medicine and surgery which were based on the Sāṅkhya teaching with a methodology derived from the Nyāya-Vaiśeṣika doctrine (cf. Charaka, Sārīrasthāna, Chap. I, Vimānasthāna, Chap. VIII—also Susruta, Sārīrasthāna, Chap. 1) had founded an elaborate theory of inorganic and organic compounds, which equally admitted iso-Bhautic and hetero-Bhautic combinations. Like the Vedantists, Charaka and Susruta held that each of the gross Bhūtas (Mahābhūtas) is a peculiar ultra-chemical compound of five original subtile Bhūtas. In this sense, every substance is penta-Bhautic, but for purposes of chemical analysis and synthesis, *i. e.* considered with reference to the Mahābhūtas, all substances in their chemical constitution, belong to

one or other of the following classes: Mono-Bhautic, bi-Bhautic, tri-Bhautic, tetra-Bhautic, and penta-Bhautic. Compounds of different Bhútas, again, may combine to form more complex substances, and these in their turn, higher compounds still, and so on in progressive transformation, as is more specially the case with organic substances and products.

**Physical characters of the Bhútas:** The prevailing physical characters of the different Bhútas and their isomeric modes are enumerated as follows.

**Earth-substances**—Heavy, rough, hard, inert, dense, opaque, exciting the sense of smell.

**Ap-substances**—Liquid, viscous, cold, soft, slippery, fluid, exciting the sense of taste.

**Tejas-substances**—Hot, penetrative, subtle, light, dry, clear, rarefied, and luminous.

**Váyu-substances**—Light, cold, dry, transparent, rarefied, impingent.

**Ákāśa-substances**—imponderable (or light), rarefied, elastic, capable of sound (vibrations).

(युद्ध चर कठिन मन्द स्मिराविषद्वान्-सूक्ष्म गन्ध-लघु-वायु-पारिवर्तन । द्रव क्षिप्त शीत मन्द बहु मिश्रित-वदरमसुखवत्-)

मानि आकाशानि । उष्ण तीक्ष्ण सूक्ष्मबुद्धिविषदरूपगुणवस्तुमानि  
आग्नेयानि । द्रव्य शीत कृच्छ्र खर विषद सूक्ष्म स्वर्ण गुणवस्तु-  
मानि वायवानि । शब्द बभ्रु सूक्ष्म मृदुल शङ्कुगुणवस्तुमानि  
आकाशानि ।—Charaka, S'árirasthána, Chap. 26 ;  
compare Susruta, S'útrasthána, Chap. 41 ).

Charaka points out that the primary qualities or specific physical characters of the five Bhútas are tactile qualities, *i. e.* sensible to touch, *e. g.* hardness ( or roughness ) for Earth, liquidity ( or yielding to pressure ) for Ap, impelling or moving force ( pressure ) for Váyu, heat for Tejas; and Vacuum ( non-resistance, penetrability ) for A'kása.

(खरदृक्चक्षुष्यत्व' भूजमानिभूतेजसाम्,

आकाशस्याप्रतीधानो दृष्ट' लिङ्ग' यथाक्रमम् ।

वक्ष्येणं सत्यमेवेतत् स्वर्गनेन्द्रियगोचरः ।

Charaka-S'árirasthána, Chap. I ).

( cf. the elaborate enumeration of physical characters quoted in Vijñána-bhikshu, Yoga-Vártika, S'útra 42, Pada I ;—also Varavara's commentary on Tattva-traya, Achit-prakarana ).

The Mahá-Bhútas—mechanical mixtures :—  
Susruta notes that each of the gross Bhútas ( Mahá-  
bhútas ) is found mixed up with the other Bhútas ;  
—*e. g.*, the Mahábhúta A'kása is the receptacle ( or  
vehicle ) of air, heat-and-light, and water vapour ;  
the Mahábhúta Váyu, of water-vapour, light-and  
heat, and even fine particles of Earth held in

suspension; the Mahábhúta Tejas, of earth-particles in the shape of smoke, and also water-vapour.

(अन्योऽन्यानुप्रविष्टानि सर्वाण्येतानि निर्हिमेत्—Susruta Sárirasthāna Chap. I.) अन्ये पुनः अन्यथा व्याचक्षते । आकाशे पवन-दहन-तोषानि । वायौ तेजोऽम्बुनी । भूरपि अणुताविशेषेण । भूमिरपि धूमादिरूपेण तेजसि । तेजोद्भवे पानीवमपि ।—Dalvaṇa on Susruta, loc. cit.)

Mono-Bhautic Earth-substances :—Charaka and Susruta regard the following as Earth-substances—Gold, the five Lohas (silver, copper, lead, iron and tin) and their 'rust', arsenic, orpiment, various mineral earths and salts, sand, precious stones. (Charaka, Sūtrasthāna, Chap. I. Cf. also Susruta, Sūtrasthāna, Chap. I. पार्थिवाः सुवर्णं रजतमाम्बुसुक्तामनः-शिलावृत्तकपालादयः । सुवर्णस्य इह पार्थिवत्वमेवाङ्गीक्रियते गुरुत्वकाठिन्यस्यैवादिहेतुभिः । सूत्रे आदिपदभावात् सोऽहमव-सिकतासुधा कुरिताश्च चपला गैरिकरसाञ्जनं प्रभृतीनां—Dalvaṇa on Susruta, loc. cit.)

The salts include common salt, saltpetre etc. Susruta mentions the alkalis, borax, natron, Yavakshāra (carbonate of potash) etc.

Of these Earth-substances, some were known to be compounds, *e.g.* the chemical salts of the metals, collyrium etc. Susruta describes the preparation of the metallic salts. The leaves of the metals were pasted over with the salts, and then

roasted (अवस्फुटित) (Chikitsásthána, Chap. 10). These metallic salts are therefore mono-Bhautic Earth-compounds. Susruta also gives the preparation of mild and caustic alkalis. (Sútrasthána, Chap. 11).

Ap-substances, simple and compound :—

Susruta, following Charaka, enumerates various classes of Ap-substances (द्रवद्रव्य) as follows :—waters, acids, milks, curds, butters, oils (vegetable as well as animal), fats, honies, molasses, alcoholic liquors, urines etc.

Pure Ap (Mahábhúta) is tasteless and the six tastes are developed when the Mahábhúta Ap enters into combination, mechanical or chemical, with other Mahábhútas. Susruta notes that various kinds of Earths are dissolved in the waters of different localities, and where the particles so dissolved are predominantly Earthy, the water tastes acid or salt,—where predominantly watery, the resulting taste is sweet,—where the Earth particles are mixed up with Tejas, the water tastes pungent or bitter etc. Such is the case with mechanical mixtures. In the case of bi-Bhautic or tri-Bhautic compounds Charaka mentions that substances with Mahábhúta Ap predominating in their composition taste sweet ; with Mahábhútas Earth and Tejas predominating, acid ; with Mahábhútas Ap and Tejas predominating, salt ; with Mahábhútas Váyu and Tejas predominating, pun-

gent; with Mahābhūtas Vāyu and Ākāśa predominating, bitter; and with Mahābhūtas Vāyu and Earth predominating, astringent. (Charaka, Sūtrasthāna, Chap. 26,—cf. Susruta, Sūtrasthāna, Chap. 42).

In fact with the exception of Susruta's waters, which are mechanical mixtures, or rather solutions, all these Ap-substances are organic products, and, as such, penta-Bhautic, *i. e.* compounded of all the five Mahābhūtas, and the particular 'taste' which is developed depends on the relative proportion of the Mahābhūtas, and the predominance of one or more of them in the penta-Bhautic compound in question.

Qualities of Compounds.—The isomeric modes of each Mahābhūta have specific colours, tastes etc. due to their structure, *i. e.* the arrangement of their atoms, and the physico-chemical characters of compounds whether of the same or of different Mahābhūtas result from the collocation in unequal proportion of the different forces latent in the atoms of the component substances. Charaka adds that the varied forms (textures) and colours of organic substances, whether vegetable or animal, are derived in the same way.

एषमेतेषां रसानां षट्त्वबुधपदं त्वनातिरेकविशेषात् कला-  
भूतानाम् । भूतानामिव खादरजकृत्मानां नावापचक्रि-  
विशेषाः ।

Susruta ignores Charaka's distinction between Mahábhūta and subtile Bhūta, and views every substance as in reality penta-Bhautic, and it is only the relative predominance of a particular Bhūta or Bhūtas in any substance that determines its class. (पृथिव्यग्नेजोवाय्वाकाशानां तनुदावाद् द्रव्यानिर्दिष्टिः । उत्कण्ठु अभिव्यक्तको भवति इदं पार्थिवं इदं आग्नेयं इदं तेजसं इदं वायव्यं इदं आकाशोदिति । Susruta, Sūtrasthāna, Chap. 41 ).

The extant Charaka and Susruta—Succession of medical authorities :—

The extant Charaka and Susruta, the sources of our present information regarding the progress of scientific knowledge in the medical schools of Ancient India, are both redactions of original authorities. The extant Charaka is a redaction by Dridhabala of the genuine Charaka Samhitā, which was itself a redaction by Charaka of the original work of Agnivesa, the disciple of A'treya Punarvasu as distinguished from Krishnātreya and Bhikshu A'treya, also well-known medical authorities. The extant Susruta is a redaction by Nágárjuna of an original work (Vridhdha Susruta) by Susruta, the disciple of Dhanvantari. That Charaka preceded Susruta is almost certain. Nágárjuna was probably earlier than Dridhabala. This Nágárjuna is believed to have been the author of a commentary on Patañjali's Mahābhāshya (vide

Bhojavṛitti and Chakrapāṇi), and was probably identical with the alchemist Nāgārjuna (Siddha Nāgārjuna), the metallurgist Nāgārjuna (author of a treatise on metallurgy, Lohasāstra), and the Buddhist Nāgārjuna, author of the Mādhyamika sūtravṛitti. Charaka and Susruta continued to receive additions after Dṛidhabala and Nāgārjuna, and even after Vāgbhaṭa, but the whole of the extant Charaka is probably much earlier than the commentator Chakrapāṇi, and the whole of the extant Susruta earlier than Dalvana, the commentator, and Mādhava, the author of Rugvinischaya. The extracts in Vāgbhaṭa make it certain that the passages I have quoted or shall quote from the Sūtrasthāna and Śārīrasthāna of Charaka and Susruta cannot be later than the sixth century of the Christian era.

**Preparation of Chemical Compounds.**—The knowledge of chemical compounds and of their preparation continued to make progress in the Charaka and Susruta Schools. The great metallurgist, Patañjali, in his treatise on Metallurgy (बौद्धयान्न) gave elaborate directions for many metallurgic and chemical processes specially the preparation of the metallic salts, alloys and amalgams, and the extraction, purification and assaying of metals. Probably it was Patañjali who discovered the use of the mixtures called Viḍas, which contained aqua regia or other mineral acids

in potentia. Unfortunately Patañjali's *magnum opus* appears to have been lost, but extracts from it are frequently found in mediæval works on Medicine and Rasáyana, which leave no doubt as to its remarkable scientific value. The metallurgist Nágárjuna advanced the knowledge of chemical compounds by his preparations of mercury. The Harshacharita, in the seventh century, relates a fable concerning this Nágárjuna, and speaks of him as a friend and contemporary of Sátaváhana. The relative priority of Patañjali and Nágárjuna is a vexed question in the history of metallurgy. That Nágárjuna's Lohasástra was earlier than the final redaction of Patañjali will appear from the following circumstances :—(1) Chakradatta in his summary of Nágárjuna mentions that the chemical process of testing pure iron must be repeated twice before it can be regarded as decisive, whereas S'ivadása Sen's extract from Patañjali shows that the latter directed the process to be repeated seven times ; (2) Patañjali in the Abhraka-vidhi (mica operation) adds mercury, which in this particular operation is wanting in Nágárjuna's recipe ( cf. Chakradatta, and Patañjali as reported in the Yogaratnákara-samuchchaya ) ; and (3) Nágárjuna is quoted in the earlier compilations, Patañjali in the later.

Early in the sixth century, Varáhamihira in the *Vrat Samhitá* gives several preparations of

cements or powders called Vajra-lepa, "cements strong as the thunderbolt;" and there was ample use for these in the temple architecture of the Buddhist period, the remains of which bear testimony to the adamant strength of these metal or rock cements. (द्रासदहर्णयवनीवि-

प्रतिभासु कुडमूपेण सन्तप्तो दास्यो नर्तकः ।  
Chapter 56. *Ibid*). Varāhamihira also alludes to  
the experts in machinery (वन्धविदः, वन्द्याः) and the  
professional experts in the composition of dyes and  
cosmetics (रागनखकुम्भिविदः Ch.16, also Ch.15). I would  
also refer to the interesting Chapter on cosmetics  
(Ch. 76) where Varāhamihira gives various recipes  
for artificial imitations of natural flower scents as  
of the essence of Vakula, Utpala, Champaka,  
Atimuktaka &c., arranges compound scents in a  
sort of scale according to the proportions of cer-  
tain ground essences used in their preparation,  
and determines by the mathematical calculus  
of combination (लोहकप्रकार ) the number of  
variations of the different notes in this scale.  
To these classes of professional experts were  
due three of the great Indian discoveries in the  
chemical arts and manufactures which enabled  
India to command for more than a thousand years  
the markets of the East as well as the West and  
secured to her an easy and universally recognised  
pre-eminence among the nations of the world in

manufactures and exports :—(1) the preparation of fast dyes for textile fabrics by the treatment of natural dyes like Mañjishtā with alum (सुवर्दी मंजिष्ठा रागवन्निवी) and other chemicals (*e.g.* sulphate of iron) also cow-dung, (cf. the “cowdung substitute”, Roscoe); (2) the extraction of the principle of indigotin from the indigo plant by a process which however crude is essentially an anticipation of modern chemical methods; and (3) the tempering of steel in a manner worthy of advanced metallurgy, a process to which the mediæval world owed its Damascus swords. It was this applied chemistry much more than handicraft skill which gave India her premier position in the middle ages and earlier (indeed from Pliny to Tavernier) in exports and manufactures; for in handicraft skill as in design and workmanship, great as were her merits, India came to be surpassed by her disciples China and Japan.

The Vāsavadattā and the Dasakumāra Charita in the sixth century allude to the preparation of a mass of fixed or coagulated mercury (पारद-पिण्ड इव काष्ठधातुवादिनः—वासवदत्ता); a chemical powder, the inhalation of which would bring on deep sleep or stupor (योगवृक्ष—दशकुमारचरित); a chemically prepared stick or wick for producing light without fire (योगवृक्षिका—दशकुमारचरित); and a powder which like anæsthetic drugs or curare, paralyses

sensory and motor organs ( *संज्ञानभूतां निव इन्द्रियाणाम्* — *वासवदत्ता* — *धीन्द्रियवत्सर्ग इन्द्रियाणां दर्पणः* ). *Vrinda* ( circa 950 A. D. ) notices the preparation of sulphide of mercury ( *इसान्द्रनभूतं* ) composed of one part of sulphur, and half its weight of mercury ; and also of cuprous sulphide ( *पर्वटिनाम्* ). *Chakrapāni* ( circa 1050 A. D. ) mentions the preparation of the black sulphide of mercury, "by taking equal parts of mercury and sulphur".

The *Rasārṇava* ( circa 1200 A. D. ) notices the colours of metallic flames, probably after *Patañjali* ; *e. g.* copper gives blue flame ; — tin, pigeon-coloured ; lead, pale ; iron, tawny ; blue vitriol, red. It may be noted that the *Rasārṇava* regards mercury as a penta-Bhautic substance.

The *Rasaratna-samuchchaya* divides the mineral kingdom ( Earth-substances, simple and compound ) into the following classes :— (1) The eight *Rasas*, mica, pyrites, bitumen, blue vitriol, calamine, etc. (2) The eight *Upa-rasas* ( useful in operations of mercury ), sulphur, red ochre, green vitriol, alum, orpiment, realgar, collyrium, and medicinal earth, to which may be added the eight *Sādhārana Rasas*, sal-ammoniac, cowrie, cinnabar, rock vermilion, etc. (3) The gems, diamond, emerald, sapphire, cat's eye, sun-stone, moon-stone, pearl, etc. (4) The metals,

gold, silver, iron, copper, lead, tin, and the alloys—brass and bell-metal. Other Earth-substances are six salts, three alkalis, mineral earths, and several poisons ( cf. vol. I, pp. 32-98 ).

Chemical compositions and decompositions—metallurgic processes.—In these writings, we frequently come across instances of chemical composition and decomposition, by processes, more or less crude, of calcination, distillation, sublimation, steaming, fixation, etc. ( भस्मीकरण, जलपातन, ऊर्ध्वपातन, खेदन, साधन etc. ) *e. g.* the preparation of perchloride of mercury by taking common salt and mercury ( रसकूर्पूर—पारदस्य सेन-भस्मीकरणे चन्द्रिकाकारः ); of sulphide of mercury ( हिङ्गुज ) by taking sulphur and mercury, of Sindūra from lead ( हिङ्गुरं नागसन्धानम्—Amara-kosha );—of the medicinal compounds, Svarna-sindūra and Rasasindūra, with mercury, sulphur and gold, where gold may have been fancied to influence the resulting compound in some mysterious way, either as a 'dynamic' or as a catalytic ;—also the extraction by chemical decomposition of mercury from sulphide of mercury ( हिङ्गुज,—vide रसरत्नसङ्ग्रह ) ; of copper from sulphate of copper ( ताम्र, वल्लक ) by heating this substance with one-fourth of its weight of borax ( Rasaratna-samuchchaya,—cf. Bhāvaprakāśa, ताम्र

तुलाजीयभासु विविधां ताज्जीय बह्वर्थाः); of zinc (बहुधा, जलद) from calamine (हस्त—Rasárnava); of copper from pyrites (जाग्रिष, विजग, etc.—Rasárnava, (though the golden pyrites were supposed to be a semi-metal of gold, containing some gold along with the essence of copper)—the purification of mercury by repeated distillation from lead and tin with which it is used to be adulterated in the market. The various metallurgic processes described are—extraction, purification, killing (formation of oxides, chlorides and oxy-chlorides for the most part), calcination, incineration, powdering, solution, distillation, precipitation, rinsing (or washing), drying, steaming, melting, casting, filing, etc. to all which each of the known minerals was successfully subjected by the use of apparatus and reagents and the application of heat in different measures (हरपाक—नक्षत्रपाक— and नदुपाक),—methods which, if often crude, especially from the absence of independent and isolated mineral acids, were yet in several instances remarkably simple and effective, and which, after all by the use of various *Vidas* potentially containing mineral acids (aqua regia, sulphuric acid, hydrochloric acid, etc.) virtually accomplished the practical ends kept in view. To these were added several special processes for mercury (*e.g.* fixation), bringing up the number of mercurial operations to nineteen.

It may be noted that the mixtures called *Vidas*, which potentially contained dilute mineral acids, were regularly employed not only in killing the metals (forming their oxides and chlorides), but—what is of fundamental importance—for purposes of chemical decomposition of metallic salts, etc. and the extraction and purification of metals.

**Organic Compounds.**—Organic Compounds are either vegetable or animal substances. (खावर जङ्गल भूत). The molasses, the fermented liquors, the saps and juices of plants, fruit acids, vegetable ashes and alkalis together with the tissues of plants, are vegetable compounds (ज्योतिह, खावर भूत). Honey, milk, curd, butter, fat, bile, urine, and other excreta, together with the organs and tissues of animals, are animal substances. Charaka notices vegetable as well as animal oils. The viscous (oily) substances are classed under four heads—butters, oils, fats, and marrows (वर्षितानं वसा मज्जा कोहो दृढश्चतुर्विधः). Salt may be either mineral or vegetable salt.

Susruta divides poisons into two classes—Vegetable and animal, but several poisons expressly termed mineral poisons (धातुविष) are included in the first class.

All organic substances, whether animal or vegetable, are penta-Bhautic, being compounded

of greater or less proportions of the five Mahá-bhútas.

Taking the human body Charaka finds that the foetus is composed of sixteen organic substances, viz. four, composing the Sperm-cell which comes from the male ; four composing the germ-cell which comes from the female ; four added by the transformation of the nutritive material, and finally, four kinds of subtile matter, which together form the vehicle of the conscious principle. As to the four organic substances which compose the sperm-cell, or the other four which compose the germ-cell, it is not clear whether in Charaka's view they are also in their turn compounded of less complex organic substances, or whether their constituent elements are inorganic penta-Bhautic compounds.

The tissues that appear in the course of development of the foetus are further transformations ( higher compounds ) of these foetal substances. All the component substances of the body are penta-Bhautic compounds, though sometimes they are assigned to the particular Bhútas which predominate in their composition, *e.g.* bile to Tejas, lymph, chyle, blood, fat, urine, sweat and other secretions to Ap, and skin, flesh, bones, nails, hair, etc. to Earth. ( शुक्रं वायुनिधूस्यवसुधापादवत् ।—  
गर्भस्य चत्वारि चतुर्विधानि भूतानि मातापितृसन्धवानि आकाश-

जानि आत्मज्ञानानि चैव et seq. Charaka, S'árirasthána, Chap. II. vide also Charaka, S'árirasthána, Chap. VII. cf. Gaṅgádhara's Jalpakaalpataru. पित्तं तृतीयं भूतं शरीरादन्धकमेवः प्रधानवस्तुभूतविकारात्मकं तेजःस्वरूपं अग्नि-  
संज्ञम् । अक्षय्यसर्वं भूतमायः शरीरादन्धकसोमप्रधानवस्तुभूत-  
विकारविज्ञैवः । शरीरं तु पञ्चमहाभूतविकारसमुदायात्मकम् ।  
Cf. Charaka, S'árirasthána, Chap. IV. नाहन्नाद्बोधि  
अह्न नह्यभूतविकाराः । )

Foetal Development (after Susruta). The ovum fertilised by the sperm-cell and developing under the influence of animal heat forms successive layers and tissues. even as layers of cells and fibres are formed in wood. First are formed seven layers epithelial and dermal (सप्तत्वचः), then follow the several tissues (कक्षाः), the flesh, the vascular tissue, the fat and marrow, the lymphatic (and glandular) tissue, the intestinal tissues, the biliary and the seminal vessels. Tissues which are regarded by some as modifications of the original dermal layers of the ovum (cf. the layers of the blasto-derm and their relation to the tissues in Embryology). The tissues are supposed to be developed successively, one out of another, by chemical action or metabolism (पाच), e. g. chyle is transformed into blood, blood into flesh, flesh into fat, fat into bone, bone into marrow, marrow into sperm-cell. The organs are next formed out of the tissues.

The liver, gall-bladder (जीव), spleen and lungs are referred to the blood; the intestines to the blood, lymph and bile; the kidneys to the blood and fat; the testicles to the blood, lymph and fat; the heart to the blood and lymph; and the tongue to the lymph, blood and flesh. Vāyu, with the accompaniment of animal heat, impels the 'currents' (स्रोतांसि) in the system; Vāyu acting on the flesh gives rise to the muscles, and it is Vāyu again, which, with the essence of fat (or marrow), produces the nerves, arteries and tendons. (तस्य खलु शुक्रशोणितस्य अभिव्यक्तमागस्य बीरस्यैव सन्धानिकाः सप्तत्वयो भवन्ति ।—कलाः खल्वपि सप्त सन्धावन्ति । वक्त्राद् वारः काष्ठेभ्यु, हिरण्मन्त्रेभ्यु, इत्यन्ते । तार्वा प्रथमा मांसधरा । द्वितीया रक्तधरा । तृतीया नेदोधरा । चतुर्थी श्लेष्मधरा । पञ्चमी पुटीधरा । षष्ठी पित्तधरा । सप्तमी शुक्रधरा ।—गमस्य वक्त्राद् वानौ शोणित-जौ ।—et seq Susruta, S'árirasthána, Chap. IV.—  
रवाद्भूतं ततो मांसं मांसान्मोदः प्रजायते । नेदोऽस्ति ततो मज्जा नद्यः शुक्रस्य सन्धवः । S'útrasthána, Chap. XIV).

The following parts (tissues and organs) in the foetus are in a special sense modifications of the four organic substances contributed by the sperm-cell of the male parent; hair, nails, teeth, bones, nerves, veins and arteries, tendons and ligaments, and the sperm-cell; the following, of the substances derived from the mother,—skin, blood,

flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc. (Charaka, S'árirasthána, Chap. III. वाणि खलुस्य गर्भस्य पित्तजानि पित्ततः सन्भवतः सन्भवन्ति. तद्वया केश-शङ्ख-मण्ड-होम-दन्तास्त्रिशिरा-स्नायु-धमन्यः शुक्रमिति पित्तजानि। वाणि खलुस्य गर्भस्य मातृजानि वाणि च खस्य मातृतः सन्भवतः सन्भवन्ति—तद्वया त्वक् च बोद्धित्तम् कांस्य मेदश्च हृदयं च वलत् च मूर्ध्ना च उक्षौ च पुरीषाधानं च आमाशयश्च इति मातृजानि।)

**Chemistry of Digestion**—The food we eat contains five classes of penta-Bhautic organic compounds. From their radicles or predominant elements, the substances are named Earth-compounds, Ap-compounds, Tejas-compounds, Váyu-compounds and A'kása-compounds. The Earth-compounds supply the hard formed matter of the body, the Tejas-compounds give the animal heat (or the metabolic heat), the Váyu-compounds are the sources of the motor force in the organism, the Ap-compounds furnish the watery parts of the organic fluids, and the A'kása-compounds contribute to the finer etheric essence which is the vehicle of the conscious life. Roughly speaking, the Earth-compounds answer to the nitrogen compounds in the food, the Tejas-compounds to the hydro-carbons (heat-producing) and the Váyu-compounds to the carbo-hydrates (dynamic). The Ap-compounds are the watery parts of food.

and drink. The flesh, for example, is a tissue composed principally of the Earth-compounds, the fat of the Earth and Ap compounds, the bones of Earth, Váyu and Tejas compounds. For purposes of digestion it is stated that different operations of the metabolic heat (perhaps different digestive fluids are also meant) are required to digest the different substances in the food.

The course of metabolism is described as follows:—The entire alimentary canal is called Mahásrotas ( the great channel ).

The food goes down the gullet by the action of the biomotor force, the Prána-Váyu.

In the stomach ( **आनाशय** ) the food becomes mixed up first with a gelatinous mucus ( **केसीयुतं कर्म** ) which has a saccharine taste, and then gets acidulated by the further chemical action of a digestive juice ( **विदाह्यद्भुतां गतः** :—evidently the gastric juice is meant ). Then the biomotor force, the Samána Váyu, begins to act and drives down the chyle by means of the Grahani Nádi to the Pittá-saya (duodenum), into which bile comes down from the liver, and thence to the small intestines ( the **आमपक्वाशय** ). In these, the bile ( or rather the digestive substance in the bile as opposed to the colouring element ) acts on the chyme, and converts the latter into chyle ( **रस** ), which has at first

flesh, fat, the heart, liver and spleen, kidneys, stomach, intestines, etc. (Charaka, S'árirasthána, Chap. III. वाणि खलुस्य गर्भस्य पित्तजानि पित्ततः सन्भवन्तः सन्भवन्ति, तद्द्वया मेदः-श्नानु-नख-लोम-दन्तास्त्रिधिरा-स्त्रायु-धमन्यः पुनर्निनि पित्तजानि । वाणि खलुस्य गर्भस्य मातृजानि वाणि च अस्य मातृजः सन्भवतः सन्भवन्ति—तद्द्वया त्वक् च कोष्ठमस्य नासिका मेदश्च हृदयं च वलत् च शीघ्रा च उक्षौ च पुरीषाधानं च आमाशयश्च इति मातृजानि ।)

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a katu taste (pungency). This chyle contains in a decomposed and metamorphosed condition all the penta-Bhautic organic compounds, viz. tissue-producing Earth-compounds, water parts or Ap-compounds, heat-producing Tejas-compounds, force-producing Vāyu-compounds, and lastly, finer etheric constituents which serve as the vehicle of consciousness. The essence of chyle (सूक्ष्मभोजन) from the small intestines is driven by the biomotor force, the Prāna Vāyu, along a Dhamanī trunk (cf. the thoracic duct) first to the heart (which is a great receptacle of chyle), and thence to the liver (and the spleen), and in the liver, the colouring substance in the bile acts on the essence of chyle, especially on the Tejas substance therein, and imparts to it a red pigment, transforming it into blood. But the grosser part of chyle (सूक्ष्मभोजन) proceeds along the Dhamanīs, being driven by the biomotor force, the Vyāna Vāyu, all over the body.

When the blood has been formed, the essence of chyle in the blood, acted on by Vāyu (biomotor force) and Mānsāgni (the flesh forming metabolic heat), forms the flesh-tissue, the Earth-compound of the food substance especially contributing to this tissue of the flesh tissue thus formed, the grosser part goes to feed or replenish the flesh tissue all over the body. The finer essence of flesh in the

blood in the chyle, acted on again by Vāyu (biomotor current) and the fat-forming metabolic heat (जैराज्ज) in the menstruum of lymph (सर्प दध्नाद्वय), receives viscosity and whiteness, and produces the fatty tissue, the Earth-compounds and Ap-compounds of the food especially contributing to the product. This fat in the chyle (or blood), or rather the grosser part of it replenishes the fatty tissue of the body, but the finer essence of fat in the flesh in the blood in the chyle, acted on by Vāyu (biomotor current) and the marrow-forming metabolic heat, in the menstruum of lymph (सर्प दध्नाद्वय), becomes hard (or crystalline), and forms bone, the Earth, Vāyu and Tejas compounds contributing principally to the product. The essence of the fat fills the hollow channels of the bones, and acted on again by biomotor Vāyu and metabolic heat, becomes transformed into the marrow. The marrow is transformed into the semen, which is conveyed down by means of a pair of Dhamanis (ducts) (इ दध्नाद्वय), lodged in its receptacles (सुक्रधरा—दध्नाद्वय) and discharged by means of another pair of ducts (इ दध्नाद्वय). The semen, or rather all the elements in their finer essence, give off Ojas, which returns to the heart, the receptacle of chyle and blood, and again floods the body, and sustains the tissues, thus completing the wheel (or self-return-

ing circle) of metabolism (परिवर्तन चक्र. Cf. Charaka and Vagbhata ).

It is to be noted that, throughout, the fluid in the chyle ( or blood ) acts as the menstruum, though occasionally the lymph, which is itself a derivative from the chyle is added as in the case of the fatty tissue and the marrow ; and that each preceding element or constituent of the body (बाह्य-वर्तमानवस्तु, takes up the proper organic compounds from the food-chyle to form the next element or tissue. Throughout also, the chemical changes are due to the metabolic heat which breaks up the compounds and recombines, but the operations and even the vehicles perhaps of this heat are different. For example, these heat-corpuscles in the biliary ducts produce the bile, but the bile secretion is supposed to contain two distinct substances, (1) a digestive fluid in the duodenum (द्वितीय) which acts on the chyme to produce the chyle, (चर्म-रक्त-वस्तु 'विष' ); and (2) a colouring bile-substance in the liver which adds a red pigment to the chyle and transforms it into blood (रक्त-वस्तु 'विषम्' ). Besides, there are three other biles, of which the aqueous humour in the eye is supposed to be one (आश्रित-वस्तु) helping in the formation of visual images (चक्षु-वस्तु). This is the view of Dharmatari and his school, but Atreya holds there to be no

evidence that the bile really performs the first (digestive) function, for this can be accounted for by the animal heat arising from the working of the whole bodily machine. There are three different hypotheses regarding the course of metabolism and the successive transformations of the chyle (चोदधिन्वाव-वेदादीकृत्वा-वदेवरीवन्वावेति मिथ्या वातुपीयस्यजनः—Chakrapāṇi, Bhānumati, Sūtrasthāna, Chap. 14, Śloka 10; also his commentary on Charaka, Sūtrasthāna, Chap. 28), but my account is based upon the second hypothesis which has the preference of Chakrapāṇi (चरकः). It may be added as a curiosity that each element of the body (वातु) under the metabolic heat is supposed to give off a finer essence (सूक्ष्मजम्) which serves as the material of the next succeeding element, and a gross (कृच्छ्र); which forms some of the excreta in the body, (including the nails, the hair, etc.), besides retaining its own substance (the gross or main part) which is driven along by the Vāyus (biomotor or vital currents) or by the Srotas to its destination in the body. Some idea of circulation appears to have been entertained, for the heart which receives and then sends down the chyle through the Dhāmanis gets it back transformed into blood, and the Ojas also proceeds from the heart and returns to it along with the chyle and blood. (Cf. Vāgbhata—नाः सुतुल्यः सिरिः रक्तानि जीवः



वः खेदः शुभं संजायते चरा । Charaka—*Dridhabala Samhitá*, quoted by Aruna in his commentary on Vágbhata. यथा कैदारनिषक्तं कुल्याजसं प्रत्यावृत्तं कैदारीमाश्रावयति, यथा रक्तं एव प्रयत्नं रक्तं श्रावयति । तत्र रक्तस्थान-वन्ध्याद् रक्तवाहिन्यं रक्तव्यपदेशं च अनुभवति । रक्तं च रक्तवसानेन लोकेनाग्नेन चक्षुः योयति । ततो रक्तमाश्राव्य मांसमाश्रावयति, एवमुत्तरोक्तद्वारात् एव एव श्रावयति । (Chakradatta, Bhánumatí). This passage shows that the 'venous blood' was conceived to be chyle-essence mixed with blood, and that the circulation of the chyle so far as it was held to contribute its quota to the constituent elements and tissues of the body was really supposed to be identical with the circulation of the blood (ततो रक्तमाश्राव्य मांसमाश्रावयति). This will be abundantly clear from the following account of the course of the chyle and the blood :—

ततः कार्दमूतस्याकाररक्तस्य द्वौ भागौ भवतः । सूत्रः सूक्ष्मश्च... ततः सूक्ष्मो भागः प्राणवायुना प्रेरितो धमनीमार्गेण च वाह्य-कस्य रक्तस्य स्थानं वसद्-शीघ्रकर्म गत्वा तेषु रक्तं मिलितो भवति । ततः प्र-क्तन-रक्तधानौ एव तिष्ठति । .....ततः कार्दमूतस्य व्याकार-रक्तस्य द्वौ भागौ भवतः । सूत्रः सूक्ष्मश्च । सूत्रो भागो रंज-नास्थिते पिप्पले रक्तीकृतः प्रदीपारम्भकं रक्तं योयन् चक्षु-वायुना प्रेरितो धमनीभिः संहरन् रक्तप्रदीपवसानि हृदि-राशिं दुष्णाभि । ततः सूक्ष्मो भागः व्याणवायुना प्रेरितो

चरकनिधिः विद्यमानः इतीदमस्मात्प्रति साक्षात् कति ।  
et seq.

This finer essence of chyle which nourishes the flesh must also be carried in the blood, on the 'irrigation channel' hypothesis (वेद्यदीप्तकान्ताव). (For diagrams of the central circulation and the sympathetico-spinal nervous system, *vide* Appendix. The mechanism of life and the inheritance of specific and other congenital characters are also dealt with in the Appendix.)

Formation of molecular qualities in chemical compounds :—The Charaka school, which, we have seen, was an offshoot of the Sāṅkhya (cf. Charaka, Vimānasthāna, Chap. 8, यथा वादितः प्रकाशकः तथा चरकनिधिः प्रकाशकनिधिः) supplemented the above account of inorganic and organic compounds with a characteristically Sāṅkhya explanation of the formation of molecular qualities by chemical combination. In Charaka's view, the colours, tastes, etc. of the molecules of chemical compounds result from the collocation in unequal proportion and unstable equilibrium of the different forces latent in the atoms (Paramāṇus) themselves, ईश्वरमेवैव दृष्टव्यं नृणां चरकनिधिः ईश्वरमेवैव दृष्टव्यं नृणां चरकनिधिः (Charaka.)

**Chemistry of colours.**—As an interesting example of the way in which a follower of Charaka would account for the colours of chemical compounds, I may note the explanation given by the late Gaṅgādhara Kavirāja Kaviratna in the *Jalpakaḷpataru*, a commentary on the *Charaka-Saṃhitā*, published at Calcutta in 1869, premising that the Kavirāja's view is pure and genuine Charaka doctrine. Gaṅgādhara begins with a simple statement. The qualities of the atom, he writes, tend to produce similar qualities in the molecule. A molecular quality is therefore the result of the conjunction or opposition, as the case may be, of the atomic tendencies. When, for example, the five Bhūtas combine to produce an organic compound (the human body), Tejas, Ap and Earth tend to produce red, white and black respectively, but in the body (compound substance) the yellow colour may happen to be produced as the result of these tendencies in that particular proportion and collocation. The point to note here is that the molecule forms a fresh collocation, *redistributes the Mass and Energy*, and sets up new forces in the system which coming into play modify the potencies (or tendencies) in the component atoms, and thus determine the resultant. This is elaborated into a curious but complete theory of the colours of chemical compounds.

The colours (and other qualities) of a simple substance (an isomeric mode of any Bhúta) are the result of the potencies lodged in that particular collocation of Mass, Energy and Essence. Now when two such substances unite, their colours etc. tend to be produced, but the combination brings on a fresh distribution of Energy, Mass and Essence, and the forces thus set free may powerfully modify or even extinguish the separate tendencies or potencies of the component simple substances. For example, when we prepare a collyrium by mixing equal parts of sulphur and mercury (the black sulphide of mercury) we find the resulting compound black. To explain this, it has to be remembered that each of the substances (sulphur and mercury) contains Sattva (Essence), Rajas (Energy) and Tamas (Mass) in different proportions, and that predominant Tamas (Inertia, Mass) always produces black, predominant Sattva (Essence) white, and predominant Rajas (Energy) red. Now in the black sulphide of mercury, the white of the mercury tends to produce white, and the yellow of the sulphur yellow; and if these tendencies were not obstructed, the result would be a mixed colour. But, in the particular collocation in question, the Tamas of the mercury becomes intensive (अतिव्याप्त), and the black of the now intensive Tamas

extinguishes the white in the uncombined mercury, which was due to prevailing Sattva, as well as the yellow of the uncombined sulphur, which was due to the combined operation of white-producing Sattva and red-producing Rajas. Again, when, with proper apparatus and by the application of heat, we combine mercury and sulphur to produce the red sulphide of mercury, the resulting colour is explained by the fact that in this new collocation the Rajas (Energy)—probably of the mercury, though Gaṅgādhara does not specify—becomes intensive (बीज), and extinguishing both the white-producing Sattva of the mercury and the yellow-producing Sattva-Rajas of the sulphur, imparts a red colour to the compound. In these cases, as also in the formation of red by mixing powdered turmeric with lime, *i.e.*, whenever a new colour is produced in the compound, it is to be explained by the dominance of Tamas, Rajas or Sattva, or their combinations, and the extinction of the uncombined tendencies (or potencies) by the forces set free in the new collocation. But there are other cases where the colour of the compound is a mixed colour resulting from the colours of the combining substances, *e.g.*, when sulphide of mercury and calcined tin are mixed, the resulting colour is evidently a mixed one (Pātala, pink), which is



गुणवत्त्वयोः । यच्च यवयोः यवा—हिङ्गु, वङ्गमङ्गुल-योरो नीत-  
 दोहिङ्गवर्ण-मेव कमलात्माङ्गं मन्त्रि पाटवर्णं, यच्च तल-हिङ्गु, वङ्ग-  
 दोहिङ्गं वङ्गमङ्गुलं योहिङ्गं च येनानि यज्यते । एवं गुण-  
 रूपाणिनिर्माणमप्यहं योहिङ्गमेव । ) (Jalpakaipataru, Sūtra-  
 sthāna of Charaka, pp. 198-200 ; edition publi-  
 shed by Bhubanachandra Basāk, Calcutta, Samvā-  
 daratnākara Press, Samvat 1925.) This is quite  
 in a line with Charaka's explanation of the tastes  
 of chemical compounds which has been already  
 noticed.

Parināma-vāda versus Ārambha-vāda : Charaka's  
 view of the formation of a new quality or a new  
 substance is based on the Sāṅkhya teaching as to  
 the conservation and transformation of Energy,  
 and brings chemical synthesis in a line with  
 evolutionary change (परिणाम). On this view, a  
 new substance may arise by spontaneous or isome-  
 ric change, i.e., by the inter-play of Energies within  
 the system of any given substance, in the absence  
 of any action from without. New qualities like  
 new substances are only readjustments of the  
 old, and continual changes are going on by  
 spontaneous disintegration and recombination.  
 Opposed to this evolutorial view of chemical  
 synthesis is the Nyāya-Vaiseshika doctrine of  
 Ārambha-vāda, according to which no change of  
 substance or quality, no effect, in short, can take

place except by the action of one component element (substance or quality) on another. A binary molecule, for example, cannot possess any 'specific quality' (विशेषगुण) of a kind not represented in each of the two component atoms. In the cosmic process, no atom can exist free and uncombined with another atom, and every 'specific quality' in a substance can be ultimately analysed into the union of two 'specific qualities' *of the same class* in two ultimate particles which cannot be further divided. A single colour, smell or taste in a single particle; until it can link itself on to another specific quality *of its own class* in a second particle, cannot characterise any substance formed by the union of these particles as material causes. Hence an Earth-atom cannot unite with an Ap-atom, to form a new substance of which both the particles must be equally regarded as material causes. At any rate, such a compound, if effected, would be smell-less, as of the two constituent atoms, only one, viz., the Earth-atom, possesses smell. A compound of Earth and Váyu would be smell-less, colourless and tasteless, and so on. The Nyáya-Vaiseshika does not deny that there may be compounds of different Bhútas, nor does it deny the causal operation of specific qualities as efficient or energising (dynamic) causes (कारण, निमित्तकारण), but it refuses to place

these compounds on the same footing as compounds of isomeric modes of the same Bhúta ; and it accepts the 'material' causality, in such cases of only one of the Bhútas, regarding the others as co-efficients' ( निमित्तकारण).

The earlier Sāṅkhyas including the medical schools of ancient India brushed all this aside as a distinction without a difference. The Vedantists, as we shall presently see, flouted this doctrine of Ārambha-vāda. The Jainas, in opposing this Vaiseshika view of atomic combination, hit upon a solution of the problem of chemical affinity. Others again, found out a *via media*. They held, as we learn from the reports of Udyotakara in the Nyāya-vārtika, and of Vāchaspati Misra in the Tātparyyatīkā, that a molecule of the structure EA (one atom of Earth and one of Ap) would exhibit some variety of colour and taste resulting from the joint action of the atoms and of their several colours and tastes. But as in the combination EA only the Earth-atom possesses smell, and the Ap-atom is smell-less, and as moreover no quality in a compound substance can result except from the joint action of the similar (potential) qualities of at least two component elements, it follows that a molecule of the structure EA would not manifest the energy of smell potentially contained in the Earth-atom.

Hence, admitting the combination EA for a smell-less compound, the upholders of this view would suppose a molecule of the type  $E_2A$  (*i.e.* two atoms of Earth and one of Ap) to explain any bi-Bhautic compound of Earth and Ap (like the plant saps and fruit juices) which exhibits smell in addition to the peculiarities of colour and taste. ( Cf. Vāchaspati's comment on Udyotakara's refutation of this view :—

अथमग्निवन्निः । इयिज्जात्यपरमाणुं तावद्वक् दृश्यं जगदाधु-  
मर्हतः तयोः परस्परसंयोजने न तद्वदव्यक्तत्वात् अपि गन्धवत्त्वा-  
भावाप्रकृतात् । एवं पार्थिवानुसन्धेयस्य गन्धस्य एवात्मेन जगदा-  
दव्यक्तत्वात् अपि पार्थिवपरमाणुं द्वयं एवञ्च पार्थवीयपरमाणुः  
इति अणुनामादव्यक्तत्वे गन्धवत्त्वोपपत्तिः इति साध्यम् । पर-  
माणुना दहनां जगदादव्यक्तत्वात् । तथाहि जलः परमाणुयः न  
कार्यमादहते । )

Measures of Time and Space. Size of atoms.

The Siddhānta-S'īromani gives the following measures of Time :—

30 Kshanas (क्षण) = 1 day, 2 Ghatikās = 1 Kshana,  
30 Kalās = 1 Ghatikā, 30 Kāshṭhās = 1 Kalā,  
18 Nimeśas = 1 Kāshṭhā, 30 Tatparas  
= 1 Nimeśa, and 100 Truṭis = 1 Tatpara.

This makes a Truṭi of time equal to  $\frac{1}{100}$  of a second, which is nearly the measure of

the Paramānu of time, as given in the Vishnu-purāna (vide Bhāskara's Siddhānta-Sīromani—  
वासनावाध्याय ) ।

The above measures were in use among the astronomers, but the physicists computed according to the following table given both in Udayana's Kiranāvali and Śrīdhara's Nyāyakandali :—30 Muḥūrtas = 1 day (24 hours), 30 Kalās = 1 Muḥūrta, 30 Kāśthās = 1 Kalā, 18 Nimeshas = 1 Kāśthā, 2 Lavas = 1 Nimesha, 2 Kshanas = 1 Lava.

अक्षयं क्षणः प्रोक्तो निमेषस्तु क्षणद्वयम् ।

अष्टादशनिमेषस्तु काष्ठा त्रिंशत् क्षणाः कला ।

त्रिंशत्क्षणा मुहूर्तः स्यात् त्रिंशद्दशमहर्षिकीर्तते ।

( Udayana, Kiranāvali ).

This makes 1 Kshana of the Nyāya-Vaisesika equal to  $\frac{1}{48}$  of a second. The Nyāya assumes that the unit of physical change ( or the time occupied by any single antecedent step in a causal series before the succeeding step is ushered in ) is equal to a Kshana ( or  $\frac{1}{48}$  of a second ). The astronomers were familiar with far smaller measures of time. The astronomical Truṭi of time measures about the thirty-four-thousandth part of a second. This is of special value in determining the exact character of Bhāskara's claim to be regarded as the precursor of Newton in the discovery of the principle of the Differential Cal-

culus, as well as in its application to astronomical problems and computations. This claim, as I proceed to show, is absolutely established ; it is indeed far stronger than Archimedes's to the conception of a rudimentary process of Integration. Bhāskara in computing the "instantaneous motion" ( *तत्कालिको गति* ) of a planet compares its successive positions, and regards its motion as constant during the interval (which of course cannot be greater than a Truti of time, though it may be indefinitely less). This *tātkālika* motion is no other than the differential of the planet's longitude, and Bāpudeva S'āstrī claims that both the conception of the instantaneous motion and *the method of determining it* plainly show that Bhāskara was acquainted with the principle of the Differential Calculus. On the data before him, Mr. Spottiswoode remarks that Bāpudeva S'āstrī "overstates the case." Bhāskara "makes no allusion to one of the most essential features of the Differential Calculus, *viz.* the infinitesimal magnitude of the intervals of time and space therein employed. Nor indeed is anything specifically said about the fact that the method is an approximate one." "With all these reservations" Mr. Spottiswoode continues, "it must be admitted that the formula he establishes and the method of establishing it

bear a strong analogy to the corresponding process in modern mathematical astronomy" (*viz.*, the determination of the differential of the planet's longitude,—by no means the first step in transcendental analysis or in its application to astronomy). And Mr. Spottiswoode concludes by stating that mathematicians in Europe will be surprised to learn of the existence of such a process in the age of Bhāskara (*circa* 1150 A.D. —born 1114 A.D.) Mr. Spottiswoode's second objection that Bhāskara does not specifically state that the method of the Calculus is only approximative cannot be taken seriously. The conception of limit and the computation of errors came late in the history of the Calculuses of Fluxions and Infinitesimals. For the rest, Bhāskara introduces his computation expressly as a "correction" of Brahmagupta's rough simplification. The first objection (*viz.*, that Bhāskara makes no allusion to the infinitesimal magnitude of the intervals of space and time employed) would be more to the point, if it were well founded. But it is not, and Mr. Spottiswoode's error was due to the insufficiency of the data supplied to him. As a matter of fact, even Bhāskara's unit, the *Truti* of time (or *Paramānu*), is exceedingly small as the very name implies, being about one thirty-four-thousandth of a second of time. And in the passage in which Bhāskara describes the process, he distinguishes

between Sthúla-gati and Súkshma-gati (velocity roughly measured, and measured accurately *i.e.*, by reference to indefinitely small quantities, for Súkshma, as we have seen, has always a reference to the Anu, the indefinitely small). Indeed he expressly mentions that the Sthúla-gati takes only Sthúla-kāla (finite time) into consideration, and that the determination of the Tātkālikí Gati (Súkshma-gati) must have reference to the moment (प्रतिक्षणम्), which is an indefinitely small quantity of time being of course smaller than his unit, the Truti. (Cf. इदं किञ्च सूक्ष्मा गतिः अथ सूक्ष्मा तात्कालिकी कथ्यते.....वदा आसन्नप्रतिक्षणस्य वदा तात्कालिक्या गत्या तन्निमित्तार्थं कर्तुं पुच्छते । तथा समोपचोचनम् । वदा तु दूरतरप्रतिक्षणः दूरवासनं वा चन्द्रस्य तदा आद्यवा स्थूला कर्तुं पुच्छते सूक्ष्मावस्थात् । यतश्चन्द्रगतिः महत्त्वात् प्रतिक्षणं समा न भवति अतस्तदर्थं अथ विधेयोऽभिहितः ;— nothing can be clearer than this conception of 'momentary' motion.<sup>1</sup> Bháskara, Siddhānta-Síromani, Ganitādhyāya, Gatisphutiprakarana : cf. also प्रतिक्षणं वा न समा महत्त्वतः, *ibid.*, cf. also Golādhyāya, Tātkālikí-karana-vásaná-prakarana, where Bháskara points out that the mode of computing adopted by the A'chāryya (Brahmagupta) is a rough simplification. The computation of relative motion and the idea of resolved components of motion were of course familiar to

the astronomers.—(Cf. एवं मत्वापान्त्येयं साधयार्थं  
इद्वटीवन्विन्दो गतिवत्ता चर्चो प्रसिद्धाः । *ibid.* ) I may  
add *en passant* that Bhāskara's formula for the  
computation of a table of Sines also implies his  
use of the principle of the Differential Calculus.

Measures of weight and capacity. The Amara-  
kosha mentions measures of three kinds—weight,  
length and capacity ( मानं तुल्यारूपं लिप्यतिः ).

The *Krishnala* (Guñjá, Raktiká, the black and  
red berry of the Shrub *Abrus Precatorius* ) was  
employed as a natural measure of weight. 80  
*Krishnala* berries on the average weigh 105 grains  
Troy, and this must be taken as the basis of our  
computation, though in current practice 80 *Krish-  
nalas* are taken to be equivalent to 210 grains.  
One *Krishnala* was supposed to weigh as much as  
3 medium-sized barley seeds ( मध्यं चण ), one of  
the latter as much as 6 white mustard seeds  
( गौरुचणं ), one white mustard as much as 3 Ráji  
mustard seeds ( राजि चणं ), one of these seeds  
as much as 3 *Likshas*, and one *Liksha* as much  
as 8 *Rajas* or *Trasareus*.

We now come to conventional measures. One  
gold *Máshá* was the weight of 5 *Krishnalas* of  
gold, 1 *Suvarna* or *Tolá* weighed as much as  
16 *Máshás*, and one *Pala* as much as 4 *Suvarnas*  
or *Tolás*. A *Pala* of gold therefore weighs 320  
*Krishnalas* ( Manu, Chap. VIII, Vishnu, Chap. IV,  
and Yájñavalkya, Chap. I ).

A Máshá of gold therefore would weigh  $6\frac{3}{4}$  grains; a Tolá, 105 grains, (in current practice it weighs nearly double as I have stated); and a Pala, 420 grains Troy.

The measures for silver were the following :—  
 1 Silver Máshá = 2 Krishnalas, 1 Dharana = 16 Silver Máshás, and 1 Pala = 10 Dharanas. A Pala of silver would therefore weigh 320 Krishnalas. In other words, the Pala was a fixed measure of weight, and was equal to about 420 grains Troy, or double this, if we take the Krishnala of current practice.

A Pala, which equals 320 Krishnalas, was subdivided by 4, 16 and 5 successively for gold, and by 10, 16 and 2 successively for silver. A Suvarna (or Tolá) of gold corresponds roughly to a Dharana of silver, and a gold Máshá to a silver Máshá, but the sizes (or volumes) are not the same, and we must not therefore conclude that gold was supposed to be heavier than silver in the proportion of 5 to 2.

We find that 1296 Trasarenu equal 1 Krishnala. A Trasarenu, as a measure of weight, therefore, is the equivalent of  $\frac{1}{1296}$  of a grain Troy, or double this according to current measures.

But the Trasarenu of physics is a different conception. It stands for the *minimum visibile*, i. e., as the physicists define it, that which is just discernible as a glancing particle in the slan-

ting beams of the morning ( or afternoon ) sun, coming into a dark room through a chink or orifice of a window. This is a measure of size (or rather stimulus limen).

Measures of Capacity. Here the standard was furnished by the *Kudava* (कुडवा), a vessel described as 3 *Angulis* long, 3 *Angulis* broad, and  $1\frac{1}{2}$  *Anguli* deep,—with a cubical capacity of  $13\frac{1}{2}$  cubical *Angulis*. 4 *Kudavas* = 1 *Prastha*. 4 *Prasthas* = 1 *A'dhaka*, 4 *A'dhakas* = 1 *Drona*, and 4 *Dronas* = 1 *Khári* or *Bhára*.

24 *Angulis* make 1 *Hasta*, cubit, which may be taken to be 18 or 19 inches. A *Kudava* was divided into 4 *Palas*, and there can be no doubt that originally water of the weight of 4 *Palas* was found to be actually contained in a vessel of the cubical capacity of a *Kudava*. If we take the ancient cubit to have been 19 inches, the *Kudava* would contain nearly 4 *Palas* of distilled water at 30° Centigrade. On a cubit of 18 inches, the *Kudava* would contain about  $3\frac{1}{4}$  *Palas*.

The *Kudava* in current medical practice is supposed to represent a cubical vessel, each side being 4 *Angulis*. This would give a capacity of 27 cubic inches, if we take the modern cubit of 18 inches. The *Kavirájas* take a *Kudava* to contain 8 *Palas* of water, and as 1 *Pala* = 320 *Krishnalas*, and 80 *Krishnalas* are now taken to be equal to 210 grains Troy, a vessel of a capacity

of 27 cubic inches is accordingly supposed to contain about 6720 grains Troy,—which is not very wide of the mark, being about 1·3 per cent. short for distilled water at 62° Fahrenheit.

Size of the *minimum visibile* ; size of an atom.

The supposed thickness of the just discernible mote in the sunbeam called a Paramanu in Technology, Silpa-sāstra, (and a Trasarenu in Natural Philosophy) follows directly from Varāhamihira's table :—8 Paramānus make 1 Rajas (or Ratharenu,—cp. the Manasara), 8 Rajas make 1 Vālāgra (filament of hair), 8 Vālāgras make 1 Likshā, 8 Likshās make 1 Yūkā, 8 Yūkās make 1 Yava, 8 Yavas (the Manasara has 4) make 1 Anguli (superior), 24 Angulis make 1 Hasta (cubit, esser cubit, 18 inches). The thickness of the *minimum visibile* (the finest perceptible mote in the slanting sunbeam) is therefore taken to be  $3.2^{-10}$  or  $\frac{1}{312500000}$  of an inch. The volume of a spherical Trasarenu (or Paramānu of the Silpa-sastra) would therefore be  $\frac{4}{3} \cdot \pi \cdot 3.2^{-10}$  of a cubic inch. It may be here noted that such a Trasarenu is supposed in the medical schools to contain 30 chemical atoms (Paramanus of Natural Philosophy) according to one estimate, or 60 according to another. The size of an atom must then have been conceived to be less than  $\pi \cdot 3.5^{-1} \cdot 2^{-60}$  of a cubic inch. परमाणुद्वयोवाकायविकिरणं सरोऽङ्गुलं चेति ब्रह्मसंहिता निबोधितम् यद्वा ब्रह्मेण भवति सत्या—Varāhamihira, Vṛhat-samhitā, Chap. 57, S'loka 2—जाम्बवन्ते

भानो बद्धुत्तरं दर्शनं रजो वाति नदिद्यात् परमाणुं  
 प्रथमं नदि प्रमाणात्मानम् । *ibid.*, S'loka 1,—Cf. Utpala,  
 तत्परमाणुं नाम प्रमाणं जानीयात् । प्रमाणात्मानं सर्वेषां  
 नत् प्रथममाद्यं प्रमाद्यं परमाणुसंज्ञम् । Ch. also, नपरमाणु  
 विज्ञेयः त्रिंशता परमाणुभिः ) ।

The magnitude of a Paramānu is called Pāri-  
 mādualya (परिमाणुत्व) in the Nyāya-Vaisesika,  
 the name suggesting that the Paramānus were  
 conceived to be spherical in shape. The Nyāya-  
 Vaisesika calls a Paramānu a mere point without  
 any dimensions, but in the Sāṅkhya-Patañjala,  
 a Paramānu, though indefinitely small, had still  
 dimensions, being divisible into Tanmātrās, which  
 were themselves integrations of Bhūtādi. The  
 diameter of a spherical Paramānu must have been  
 conceived to be less than  $3.2^{-30}$  of an inch (*i.e.*  
 less than the conventional Paramānu with which  
 linear measures begin), and the volume of a Para-  
 mānu would therefore, in accordance with Bhāskara's  
 formula, be smaller than  $\frac{4}{3} \pi \cdot 3^3 \cdot 2^{-60}$  or  
 $\pi \cdot 3^3 \cdot 2^{-61}$  of a cubic inch where  $\pi = \frac{1}{16} \frac{1}{16}$ . The  
 Tanmātrās were conceived as smaller still.

That these were conventional measures arbitrarily  
 assumed goes without question, for, of course,  
 the Hindus had no physical data for a mathe-  
 matical calculation of these minute quantities.  
 A Vālāgra (hair-tip, or finest filament of hair),  
 for example, is taken to be  $3.2^{-14}$  of an inch  
 thick; *i.e.* less than one five-thousandth fraction

of an inch in thickness ; and a fibril of the networks of Dhamaní or Nádí (nerve) that supply the pores of the skin (papillæ ? सुक्ष्मानि रोमकूप-प्रतिबद्धानि, Susruta ) was supposed to be about a thousandth part of the finest hair in thickness, or  $\frac{1}{1000}$  of the '*minimum visibile*,' and therefore about  $3 \cdot 10^{-12}$  of an inch thick (cf. सूक्ष्मनाडी-प्रचारतः रोमः सहस्रभागैस्तुल्यास्तु प्रचरति, Pañchadasí), but it is evident that these measures were arbitrarily fixed upon, instead of being arrived at by calculation or actual measurement. Indeed, Charaka expressly states that the number of S'írás and Dhamanís in the body (three million fifty-six thous and nine hundred ) is only a conjectural estimate (अनिर्णय्यमतः परं तर्कमेव—S'árírasthána, Chap. VII).

My account of the chemistry of the Sánkhyā-Pātañjala, and of the affiliated Yoga and medical schools, has anticipated in several points the views of the Vedānta and the Nyāya-Vaiseshika. The chemical facts, processes and apparatus are indeed common to all the schools. In the following account of the chemistry of the schools other than the Sánkhyā-Pātañjala, I will confine myself to the theory of the subject, and even of this I will attempt only the briefest outline.

The Vedāntic view :—

The Vedāntists believe Māyá to be the 'material cause' (प्रमाद्वयकारण) of the world. The power

of Mâyá is the power to realise the unreal—to impart practical Reality or mediate existence to that which does not and cannot possess absolute Reality or self-existence. Mâyá is at once real and unreal, while the Brahma ( Self ) is absolute Reality, absolute Intelligence and absolute Bliss. The world evolves out of Mâyá ( माया-परिणाम ), so that Mâyá in the Vedánta replaces the Prakṛiti of the Sāṅkhya. But Mâyá, and by implication the world, originate out of Brahma, not by a process of evolution ( परिणाम ), but of Vivarta ( self-alienation ). The self-alienation of the Absolute, acting through Mâyá, produces in the beginning A'kása, one, infinite, ubiquitous, imponderable, inert and all-pervasive. The world thus begun goes on evolving, in increasing complexity. The other Sūkshma Bhútas, classes of subtile matter, evolve from A'kása, in an ascending linear order,—A'kása giving off Váyu, Váyu giving off Tejas, Tejas giving off Ap, and Ap giving off Earth. A'kása, one, infinite, all-pervasive, has the capacity of sound. Váyu, subtile gaseous matter, emanates from the universal A'kása, and is instinct with the potential of mechanical energy (impact, pressure). ( ईदृश, प्रणामित, उन्नत, व्यूह, — वादोश्च सर्व-वेदाहेतुत्वेन सर्वविनाशकत्वात्—Vidvanmanoranjini ). Tejas, subtile radiant matter, emanates from Váyu, and contains in potentia the energy of light and heat. Ap, subtile viscous matter, is the

transformation of Tejas, and is instinct with the energy that stimulates the nerve of taste, and lastly, Earth, subtile hard matter, which is the transformation of Ap, possesses the latent energy of smell.

But the subtile rudiments of matter must be compounded in various ways, to give rise to the gross constituent matter of the world. These forms of gross matter are called Mahábhútas. There are five kinds of Mahábhúta (gross matter corresponding to the five Súkshma Bhútas (subtile matter), and the process by which a Mahábhúta is produced from the Súkshma Bhútas is called Pañchíkarana (quintuplication). All the five Súkshma Bhútas are present as ingredients, though in different proportions, in each Mahábhúta.

The Mahábhúta Earth, gross earth-matter, is composed of four parts of subtile earth-matter, and one part each of the other forms of subtile matter. The Mahábhúta Váyu is composed of four parts of subtile gaseous matter and one part each of the other forms of subtile matter. And similarly with other Mahábhútas.

Hence if ak, v, t, ap, e, represent the five forms of subtile matter (A'kása, Váyu, Tejas, Ap and Earth), and AK, V, T, AP, E, stand for the corresponding Mahábhútas, we may represent the constitution of the Mahábhútas as follows :—

$AK = ak_4. (v_1. t_1. ap_1. e_1)$ ,  $ak_4$  being the radicle.

$V = v_4. (ak_1. t_1. ap_1. e_1)$ ,  $v_4$  being the radicle.

$T = t_4. (ak_1. v_1. ap_1. e_1)$ ,  $t_4$  being the radicle.

$AP = ap_4. (ak_1. v_1. t_1. e_1)$ ,  $ap_4$  being the radicle.

$E = e_4. (ak_1. v_1. t_1. ap_1)$ ,  $e_4$  being the radicle.

In forms of gross or compounded matter, the potential energies (or qualities) become actualised. The Mahábhúta A'kása manifests sound; Váyu, sound and mechanical energy; Tejas, sound, mechanical energy and heat-light; Ap, the energy of the taste-stimulus in addition; and finally Earth, the energy of the smell-stimulus added to the foregoing.

The Pañchadasí characterises the different Mahábhútas by their typical sounds; e.g., A'kása by the echo (hollow booming sound); Váyu (air) by a sibilant sound, hissing, susurration (imitative symbol, Visi); Tejas (fire) by a puffing (or roaring) sound (imitative symbol, Bhugubhugu); Ap (water) by a liquid sound (imitative symbol Culuculu, gurgle, splash-splash, glut-glut); and finally Earth by a splitting or rattling sound, a crack or a thud (symbol, kad-kada).—Chap. II. Bhútaviveka, S'loka 3, Pañchadasí)

Others hold that A'kása, Ether, never enters as a component part, and is always one and indivisible. In this view, the four Mahábhútas—Váyu, Tejas, Ap and Earth alone are supposed to be com-

pounded, and by a process which may be called quaternion (cf. the Neo-Platonist quaternion) :—

$$V = v_1 (t_1 \cdot ap_1 \cdot e_1)$$

$$T = t_1 (v_1 \cdot ap_1 \cdot e_1)$$

$$AP = ap_1 (v_1 \cdot t_1 \cdot e_1)$$

$$E = e_1 (v_1 \cdot t_1 \cdot ap_1)$$

These compound forms, as before, are supposed to exercise their specific energies actively. Others again hold that the Mahábhútas—Tejas, Ap and Earth alone are compounded by a process named Trivrit-karana (triplication). Thus  $T = t_1 (ap_1 \cdot e_1)$ ,  $AP = ap_1 (t_1 \cdot e_1)$ ,  $E = e_1 (t_1 \cdot ap_1)$ .

The Sūkshma-bhútas are forms of homogeneous and continuous matter, without any atomicity of structure ; the Mahábhútas are composite ; but even these are regarded as continuous, and without any atomic structure. The Vedánta speaks of Anu (Paramánu) not as an ultimate indivisible discrete constituent of matter, but as the smallest conceivable quantum or measure of matter. In the Sāṅkhya doctrine, the atomic structure is ordinarily accepted. The Gunas are supposed to be परिच्छिन्न and अणु bounded and indefinitely small in size (except the Gunas giving rise to Ākāśa and Manas which are unlimited अपरिच्छिन्न) ; and hence the Tanmātras and Paramānus must be conceived to have a discrete structure.

As I have already noted in my account of the genesis of Tanmātras and Paramānus, various

schools of Vedántists ( *e.g.* the Rámánujists and the followers of Nimbárka ) combined, in the orthodox fashion of the Smṛitis and the Puráṇas, the Vedántic theosophy with the Sāṅkhya cosmology especially as regards Prakṛiti and the order of creation and dissolution. For example, the Vedánta kaustubhaprabhá, fortifying itself with texts from the Vishṇu Purána and the Subala and Gopála Upanishads, contends that, at the cosmic dissolution (Pralaya), each Mahábhúta merges into the one that preceded it in the order of creation by first disintegrating into its own proper Tanmátric form ( तन्मात्रद्वारा ), and that the Mahábhúta Ákása merges into the original Tanmátras, which then lapse into Bhútádi, the supersubtile rudiment matter, proto-matter ( Chap II, Pada 3, Sútra 14 ).

**Parináma—Evolutionary Process :—**When the Mahábhútas are once formed, the different kinds of substance are derived from them by the evolutionary process called Parináma ( परिणाम, transformation ). Matter is constantly undergoing change of state. The effect is only the cause in a new collocation ( कारणस्यैव संस्थानभावं कार्यम् ). Change is of two kinds :—

(1) Change by a spontaneous process, without external influence, including isomeric change ( स्वाभाविक परिणाम ). The Vedántists believe in

spontaneous disintegration and reintegration. Action from without, impressed force *ab extra*, is not, ~~pace~~ the Naiyāyikas, always a condition of change of state (whether of rest or of motion);—nor is it necessary that more than one substance should combine to generate another substance or variety of substance (*e.g.* the formation of curds from milk, of ice from water *etc.*) All this is directed against the Nyāya doctrine (Ārambhavāda).

(2) Change due to combination with other substances.. (द्वयान्तरसंयोग). Such combination may produce (1) a compound substance possessing like qualities with the constituents (समानानुवोदत्तपक्षि), or (2) unlike compounds with new qualities, "heteropathic effects" (विजानुवोदत्तपक्षि). Any new quality thus evolved through (chemical) combination is called *Sambhata-bhūta-dharma* (संभूतभूतधर्म). *e.g.* the intoxicating power of the fermented rice and molasses, which does not exist in the ingredients taken separately. (नद्यवोजानां प्रत्येकं अवर्तमानापि समुदायसङ्गता नद्यपक्षिः दृश्यते). This *Sambhūyakriyā* (संभूयक्रिया, समुत्पन्न) corresponds to chemical combination, and the Vedāntists, like the Sāṅkhyas, explain this only as the evolution of the latent energy (शक्तिः, समुत्पन्नशक्तिः) in a new collocation (संज्ञान, समुत्पन्न-संज्ञिगण). But, unlike the mediæval

Sāṅkhya, the Vedānta freely recognises the combination of heterogeneous Bhūtas. Thus, Earth, Ap, Tejas and Vāyu freely combine in different proportions and groupings to produce the variety of substances in the world. For example, the animal organism is a compound of all the five Bhūtas (पाञ्चभौतिक). It is not merely the concomitant or efficient causes that may be heterogeneous to the material cause, as the Naiyāyikas contend, but several heterogeneous substances (or Bhūtas) may unite as 'material causes' to produce a new substance.

The Vedāntists resolve all activity, physical, vital as well as psychical, into modes of motion, subtile cosmic motion (परिस्पन्द, सर्वलोकपरिस्पन्द—Sāṅkara; वायोः परिस्पन्दात्मकत्वात्,—प्राणस्य परिस्पन्दात्मकत्वादेव—यद्दृढं तं स्थूलं सूक्ष्मं च तदस्य मनःस्पन्दतमात्मम्—Sāṅkara); but they give a separate substantive existence to the agents, the vital principle (प्राण) and the mind (मनः), though these are also evolutionary transformations of the Sūkshma Bhūtas (forms of subtile matter). What is common to the Nyāya, the Vedānta and the Sāṅkhya is that Consciousness or Intelligence (चतन्य) transcends Matter; but the Naiyāyikas as pluralists hold that vital and psychical activities are also immaterial and cannot be resolved into motion (परिस्पन्द);—the Vedāntists resolve these activities into subtile motion, but

ascribe them to a substantive quasi-material Life Principle and Mind, the all-mirroring Intelligence (चतुर्थः) alone being immaterial and transcendent : and the Sāṅkhyas accept the substantive existence of the Mind Principle (मनः) as derived co-ordinately with the Sūkshma Bhūtas or Tanmātras from individualised Prakṛiti (Ahaṅkāra), but resolve Life into a mere resultant activity of the bodily organs, viz., the organs of sense and movement, and the psychic principle (मनः).

पञ्चीकरणः—द्विधा विधाय चैकैकं चतुर्था प्रथमं पुनः ।

सखेतरेद्वितीयांशैर्योजनात् पञ्चः पञ्च ते ।

यथा विसर्गं नृत्तौ स्फुटानां भूतानां स्फुटतरव्यवहारनाम-  
रूपस्य करणोपायतया 'विस्तृतकरणं' नृत्तं तद्वत् भूतपञ्चकसर्ग-  
नृत्तौ अपि तथा । तदानीं पञ्चीकरणान्तरं आकाशे शब्दोऽभि-  
व्यज्यते स्फुटतमेति सर्वत्र योजनायं ( विद्वन्मनोरंजिनी )—अस्ति  
हि शरीरे सर्वेषामपि भूतानां कार्यसंप्रतिपत्तिः अवकाशव्यवह-  
रणलोकेऽनकाठिन्यानां सर्वजर्जनुभवसिद्धत्वात् । अतस्तत्कारणतया  
पञ्चानि भूतानि एकस्मिन् देहे सन्तीति स्थिते तत्तत्पटयोरिव अव-  
यवावयवित्वमेव पञ्चभूतदेहयोर्युक्तं । न च साधारण्यत्वात् एक-  
द्रव्यत्वात् च आकाशस्य आरम्भकत्वानुपपत्तिरिति वाच्यं ।  
आरम्भवादस्य अनङ्गीकारात् । एकस्यापि दुग्धावयविनो दध्या-  
रम्भकत्वदर्शनात् । वस्तुतस्तु पञ्चानां भूतानां पञ्चात्मकत्वस्य  
दर्शितत्वात् आरम्भवादस्य निराकृतत्वात् च । तस्मात् सिद्धं  
शरीरं मायामौलिकमिति । Vidvanmanorañjinī.

न तावद् समानजातीयमेव आरभते न भिन्नजातीयमिति नियमो नास्ति । समवायिकारणे एव समानजातीयत्वाभ्युपगमः न कारणान्तरविषय इति तर्दापि अनेकान्तिकम् । नापि अनेकमेव आरभते नैकमिति नियमोऽस्ति । अणुमनसोराद्यकर्म्यारम्भाभ्युपगमात् । एकैको हि परमाणुश्चाद्यं स्वकर्म्यारभते न द्रव्यान्तरं संहृत्य इत्यभ्युपगम्यते । द्रव्यारम्भे एव अनेकारम्भकत्वनियम इति चेत् न परिणामाभ्युपगमात् । तद्वत् तु द्रव्यं विशेषवदवस्थान्तरं आपद्यमानं कार्यं नामाभ्युपगम्यते । तच्च कश्चित् अनेकं परिणमते मृद्दीक्षाक्षुरादिभावेन, कश्चिदेकं परिणमते क्षीरादि-दध्यादिभावेन । नेष्टरशासनं अस्ति अनेकं एव कारणं कार्यं जनयति इति । S'āṅkara, S'ārīraka-bhāṣya, Sūtra 7, Pada 3, Adhyāya II ).

The atomic theory of the Buddhists : --The Vaibhāṣhikas and the Sautrāntikas hold that the Vāyu-atoms are touch-sensibles, having impact or pressure for their characteristic property, and by aggregation form the element Vāyu; the Tejas-atoms are colour-and-touch-sensibles, having heat for their characteristic, and by aggregation form the Tejas Bhūta; the Ap-atoms are taste-colour-and touch-sensibles with a characteristic viscosity, and form the Ap-element by aggregation; and finally the Earth-atoms are smell-taste-colour-and-touch-sensibles possessing a characteristic dryness or roughness ( खरत्वं ), and by their aggregation form the Earth-element. The Bhūtas

thus originated combine to form aggregates, which are classed as inorganic substances, organisms and organs. ( कामेष्टद्रव्यकोट्युः—Udyotakara's extract from the Buddhist Sūtras, Nyāya Vārtika. Chap. I. Āhnika 1, Sūtra 14. cf. Vāchaspati's fuller extract :— कामे अष्टद्रव्यकोट्युः रणन्दः रूपधातुररूपधातुः कामधातुः— also the Buddhist commentary :— कामे कामधातौ अष्टद्रव्यकः अणुः । रूपरसगन्धस्पर्श इति चत्वारि द्रव्याणि पृथिव्यपतेजोवायुः इति चत्वारि—Vāchaspati, Tātparyyatīkā, loc.cit.—also खरस्त्रेहोणेरणन्दभावानि भूतानि—*vide* Udyotakara, Chap. III, Āhnika 2, Sūtra 12,—*Vide* also Śrīnivāsa's Vedānta-kaustubha, Chap. II. Pada 2, Sūtra 18).

The atomic theory of the Jainas :—Of the nine categories of the Jainas, that of Ajīva (the not-soul or non-Ego) consists of five entities, four of which are immaterial ( अमूर्त ), viz., merit, demerit, space and Time, and the fifth, material ( मूर्त, possessing figure ). The last is called Pudgala (matter ), and this alone is the vehicle of Energy, which is essentially kinetic, *i. e.* of the nature of motion. Everything in the world of not-soul ( the non-Ego ) is either an entity ( द्रव्य ), or a change of state in an entity ( पदार्थ ). Pudgala (matter) and its changes of state ( पदार्थ ), whether of the nature of subtile motion ( परिव्यन्द ) or of Evolution ( परिव्याप्त ), must furnish the *physical* as opposed to the *metaphysical* basis of all our explanations of Nature. Pud-

gala (Matter) exists in two forms,—*Anu* (atom) and *Skandha* (aggregate). The Jainas begin with an absolutely homogeneous mass of *Pudgalas*, which, by differentiation ( भेद ) breaks up into several kinds of atoms qualitatively determined, and by differentiation, integration, and differentiation in the integrated ( संघातात्, भेदात्, संघातभेदान्—*Umāśāṭī*, Chap. V, *Sūtra* 26 ), forms aggregates (*Skandhas*). An *Anu* has no parts, no beginning, middle or end. An *Anu* is not only infinitesimal, but also eternal and ultimate. A *Skandha* may vary from a binary aggregate ( द्वयणुक ) to an infinitum ( अनन्ताणुक ). A binary *Skandha* is an aggregate of two *Anus* (atoms), a tertiary *Skandha* is formed by the addition of an atom (*Anu*) to the binary ( द्वयणुक ) and so on *ad infinitum*. The ascending grades are (1) what can be numbered ( संख्येय ), (2) indefinitely large ( असंख्येय ), (3) infinity of the first order ( अनन्त ), (4) infinity of the second order ( अनन्तानन्त ), and so on.

#### General Properties of Matter :—

The specific characters of the *Pudgalas* (Matter) are of two kinds, (1) those which are found in atoms as well as in aggregates, and (2) those which are found only in aggregates. Qualities of touch, taste, smell and colour come under the first head.

The original Pudgalas being homogeneous and indeterminate, all sensible qualities, including the infra-sensible qualities of atoms, are the result of evolution (परिणाम). Every atom thus evolved possesses an infra-sensible (or potential) taste, smell and colour, (one kind of each) and two infra-sensible tactile qualities, *e.g.* a certain degree of roughness or smoothness (or dryness and moistness?) and of heat or cold. Earth-atoms, Ap-atoms, *etc.* are but differentiations of the originally homogeneous Pudgalas. The tactile qualities (खर, दृग्ध, उष्ण, शीत) appear first, but qualities of taste, smell and colour are involved in the possession of tactile qualities. An aggregate (Skandha), whether binary, tertiary or of a higher order, possesses (in addition to touch, taste, smell, and colour) the following physical characters:—(1) sound, (2) atomic linking, or mutual attraction and repulsion of atoms, (3) dimension, small or great, (4) figure, (5) divisibility,\* (6) opacity and casting of shadows, and (7) radiant heat and light.

Sensible qualities. Tactile qualities are of the following kinds—hardness or softness, heaviness or lightness (degrees of pressure), heat or cold, and roughness or smoothness (or dryness and viscosity?). Of these, the atoms (Anus) possess only temperature, and degrees of roughness

or smoothness, but all the four kinds of tactile qualities in different degrees and combinations characterise aggregates of matter from the binary molecule upwards. The Jainas appear to have thought that gravity was developed in molecules as the result of atomic linking. Simple tastes are of five kinds,—bitter, pungent, astringent, acid and sweet. Salt is supposed by some to be resolvable into sweet, while others consider it as a compound taste. Smells are either pleasant or unpleasant. Mallishena notes some elementary varieties of unpleasant smell, *e.g.* the smell of asafœtida, ordure, *etc.* The simple colours are five—black, blue, red, yellow and white. Sounds may be classed as loud or faint, bass (thick) or treble (hollow), clang or articulate speech.

The most remarkable contribution of the Jainas to the atomic theory relates to their analysis of atomic linking, or the mutual attraction (or repulsion) of atoms, in the formation of molecules. The question is raised in Umāsvāti's Jaina Sūtras (circa A. D. 40)—what constitutes atomic linking? Is mere contact (or juxtaposition) of atoms sufficient to cause linking? No distinction is here made between the forces that bind together atoms of the same Bhūta, and the chemical affinity of one Bhūta to another. The Jainas hold that the different classes of elementary substances (Bhūtas) are all evolved from the same primordial atoms.

अथैवः स्तम्भाश्च । उक्तं च । कारणमेव तदन्तः सूक्ष्मो नित्यश्च  
भवति परमाणुः । एकरसगन्धवर्णो हिस्यर्शः कार्यलिङ्गश्च ।  
तत्वाणवोऽवस्थाः स्तम्भास्तु वद्धा एव । स्तम्भास्तावत् संघातभेदेभ्य-  
उत्पद्यन्ते । संघाताद्भेदात् संघातभेदादिति । द्वयोः परमाणुः  
संघाताद्भिन्नप्रदेशः । द्विप्रदेशस्याणोश्च संघातात् त्रिप्रदेशः । एवं  
संख्येयवानामसंख्येयानामनन्तानां अनन्तानन्तानां च प्रदेशानां  
संघातात् प्रदेशाः । भेदादणुः । भेदादेव परमाणुः कृतपद्यते  
न संघातादिति । अत्राह । किं संयोगमात्रादेन संघातो भवति ।  
आहोस्तिदस्ति कस्यद्विशेष इति । अत्रोच्यते । सति संबन्धे  
वद्धस्य संघातो भवतीति । स्निग्धरुक्षत्वाद्भेदः । न अघन्य-  
गुणानाम् । स्निग्धरुक्षयोः पुङ्गवयोः स्पष्टयोर्बन्धो भवतीति ।  
अघन्यगुणस्निग्धानां अघन्यगुणरुक्षणां च परस्पररेण बन्धो न भव-  
तीति । उक्तं भवता अघन्यगुणवर्जानां स्निग्धानां रुक्षेण  
रुक्षणां च स्निग्धेन सह बन्धो भवतीति । अथ तुल्यगुणयोः  
किमत्यन्तप्रतिषेध इति । अत्रोच्यते । न । गुणमास्ये सदृशानां ।  
गुणमास्ये सति सदृशानां बन्धो न भवति । तद्वयथा । तुल्यगुण-  
स्निग्धस्य तुल्यगुणस्निग्धेन तुल्यगुणरुक्षस्य तुल्यगुणरुक्षेण इति ।  
अत्राह सदृशपक्षेण किमपेक्षते इति । अत्रोच्यते । गुणवैषम्ये  
सदृशानां बन्धो भवति इति । अत्राह किमविशेषेण गुणवैषम्ये  
सदृशानां बन्धो भवतीति । अत्रोच्यते । द्व्यधिकादिगुणानां तु  
द्व्यधिकादिगुणानां सदृशानां बन्धो भवति । द्विगुणाद्यधिक-  
स्निग्धेन । द्विगुणाद्यधिकस्निग्धस्य स्निग्धेन । रुक्षस्यापि  
द्विगुणाद्यधिकरुक्षस्य रुक्षेण । एकादिगुणाधिकबोस्तु सदृशयो-  
र्बन्धो न भवति । अत्राह परमाणुषु स्तम्भेषु च नैव स्यर्शादयो

गुणास्ते किं व्यवस्थिताः तेषु आहोस्तिद्व्यवस्थिता इति ।  
 अव्यवस्थितायुतः । परिणामात् । अत्राह इदो-  
 रपि बध्यमानयोगुणावस्थे इति कथं परिणामो भवति इति ।  
 उच्यते । वन्धे समाधिकौ पारिणामिकौ । वन्धे सति सम-  
 गुणस्य समगुणः परिणामको भवति । अधिकगुणो हीनस्येति ।  
 Umāsvatī, Tattvārthādhigama, Chap. V).

The Nyāya-Vaisesika chemical theory : a brief summary.

I must content myself here with a brief and rapid sketch of the chemistry of the Nyāya Vaisesika, which I shall elaborate in connection with the mechanics and physics of the ancient Hindus in a separate paper.

The relation of the specific characters of molecules (and higher aggregates) to the original atomic qualities is reduced in the Nyāya-Vaisesika to the following canons :— (a) कार्यगुणं कारणगुण-पूर्वकम् । (b) समानजातीयसंयोगः द्रव्यारम्भकः न विजातीय-संयोगः ( Here द्रव्य is used in a narrow technical sense, so as to exclude the quasi-compound substances). (c) अपाकजरूपरसगन्धस्य परिमाणैकत्वैकष्टयत्ना-गुरुतुद्रवत्वस्तेहवेगाः कारणगुणपूर्वकाः । (d) रूपरसगन्धानु-स्यस्यशब्द-परिमाणैकत्वैकष्टयत्नास्तेहाः समानजात्यारम्भकाः ।

No separate explanation is necessary, as the canons are embodied in the following exposition.

### Theory of Atomic combination :—

The four kinds of Atoms are Earth, Ap, Tejas- and Váyu atoms, possessed of characteristic mass, numerical unit, weight, fluidity (or its opposite), viscosity (or its opposite), velocity (or quantity of impressed motion—Vega); also characteristic potential colour, taste, smell or touch, not produced by the chemical operation of heat (अपाकज-रूपरसगन्धस्पर्शपरिमाणैकत्वैक-दृयक्ल-गु-रुत्वद्रूपत्वस्नेहवेगाः). A'kása has no atomic structure (निरवयव), and is absolutely inert (निष्क्रिय), being posited only as the substratum of sound, which is supposed to travel wave-like in the manifesting medium or vehicle of Váyu (air). Only the other four Bhútas unite (or disunite) in atomic or molecular forms. The orthodox view is that, the presence of Earth-atoms is necessary whenever chemical transformation under the operation of heat (पाकजात्पत्ति) takes place.

Atoms cannot exist in an uncombined state in Creation (S'iváditya, Sapta-padārthi- *vide* commentary, where, however, it is noted that still atmospheric air is believed to be monatomic in structure, *i.e.* to consist of masses of atoms in a loose uncombined state—(स्तिमितवायुस्तु परिमाणुमब्रूह एव अनारब्ध-द्रव्यः ।)

The atoms may combine in one or other of the following ways :—

I. One Earth-atom, by an original tendency, unites with another, to form a binary molecule (द्वययुक्त). In the same way, binary molecules of the other Bhútas are formed. The atoms are possessed of an inherent Parispanda (rotary or vibratory motion), and when they unite in pairs, *so long as there is no chemical operation under the action of heat corpuscles*, the original qualities of the atoms produce homogeneous qualities in the binary molecules.

The question as to the existence of a triad, a tetrad, a pentad *etc.* of atoms is one of the moot points of the Nyáya-Vaisesika. The orthodox view is that, the primordial infinitesimal particles (atoms) start with an incessant vibratory motion (अनवरतपरिस्पन्दमानापरिमितपवनादिपरमाणवः, Raghunátha S'íromani—गतिशीलत्वात् पतनव्यपदेशाः पतन्तीति, Udayana, Kusumáñjali), and an inherent impulse that drives them to unite in pairs—a sort of 'monovalency', *as it were*, exhausted with the formation of a binary molecule. The binary molecules now combine by threes, fours, fives, *etc.* to form larger aggregates as well as the variety of elementary substances, the particular collocation in any case being not only determined by physical causes, but also serving to satisfy the ends of the moral Law in creation (अदृष्ट, कर्मा). (द्वययुक्तैर्वहुभिराख्यते इत्यपि नियमो, न द्वाभ्यां । बहुषु त्वनिबन्धः । कदाचित् त्विभिरा-

रभ्यते इति । त्रयणु कनित्तुच्यते, कदाचित्तुभि रारभ्यते कदाचित् पञ्चभिरिति यथेष्टं कल्पना । अदृष्टवशात् तथा तथा तेषां व्यूहे यथा यथा तदारवधेषु अपरजानयो व्यज्जन्ते । अदृष्टकारिता सर्वभावाणां हृदिः । S'ridhara, Nyāya-Kandalī, पृथिवीनिरूपणम् । ) Cf. Vāchaspati's report, Bhāmatī, Chap. II., Pada II. Sūtra II. यदा चतुरणुकमारभते चतुर्णां द्वयणुकानामारम्भकत्वात् ). Prasastapāda appears to have originated this view ( परमाणुद्वयणुकेषु बहुत्वसंख्या—तैरारभ्ये त्रयणुकादिलक्षणे—Prasastapāda, परिमाणनिरूपणम् ); but that another view was also maintained in the Vaiseshika School is evident from the brief summary of Kanāda's system given in Utpala's commentary on the *Vṛhatsamhitā*, and this indeed also follows from S'ridhara's admissions in the *Kandalī*. On this view, also, atoms have an inherent tendency to unite, but some unite in pairs, others in triads, others in tetrads, *etc.* This may happen in two ways,—either by the atoms falling into groups of threes, fours, *etc.* direct, or by the successive addition of one atom to each preceding aggregate.

A triad ( *Tryanuka* ), then, holds together three atoms ( *Anus* ), not three binary molecules ( *Dvyanukas* ) as on the orthodox hypothesis. Similarly with tetrads, pentads, *etc.* (चतुर्विधाः परमाणवः क्षितिजज्ञानि-वायूनाम् । द्वाभ्यां परमाणुभ्यां द्वयणुकमारभ्यते त्रिभिः

परमाणुभिस्त्रयणुक्रमारभ्यते इति क्रमेण स्थूलकार्यद्रव्य-  
स्योत्पत्तिः । Utpala, Chap. I. Ś'loka 7 ; cf. also  
Ś'ridhara's admission, अथवा यदि परमाणवो द्वयणु-  
क्रमारभ्य तत्सहितास्त्रयणुक्रमारभन्ते तत्रयणुकसहितास्तु द्रव्या-  
न्तरम् तथापि कुतो विश्वस्य अयमहणम्). Ś'āṅkara  
seems to speak of two binary molecules in the  
Vaisesika as forming a tetrad, (यदापि द्वे द्वयणुके  
चतुरणुक्रमारभन्ते—Ś'ārīraka-Bhāshya, Chap. II, Pada  
20, Sūtra, II, where the Bhāmatī gives a forced  
interpretation).

These binary molecules are grouped by threes  
fours, fives, *etc.* (त्रयणुक, चतुरणुक) to form different  
isomeric modifications. The variety of Earth-  
substances is due to differences in the arrange-  
ments of the molecules, (*e.g.* their greater or less  
density, and, above all, their grouping or collocation  
व्यूह, अवयवसन्निवेश), which account for the specific  
characters (अपरजाति) manifested by these iso-  
meric substances. सा (पृथिवी) च स्थैर्याद्यवयव-  
सन्निवेशविशिष्टा अपरजातिवस्तुत्तरोपेता । Prasastapāda,  
पृथिवीनिरूपणम् । स्थैर्यं नियतत्वम् । आदिशब्दात् प्रशि-  
थिलत्वादिपरिग्रहः । परमाण्वादेषु अपरजात्यभावेऽपि अदृष्ट-  
वशात् तथा तथा तेषां व्यूहः यथा यथा तदारब्धेषु अपर-  
जातयो व्यज्यन्ते । Ś'ridhara, Kandali, *ibid.*

स्थैर्यं स्थिरता चिरकालावस्थायित्वमिति यावत् । आदि-  
ग्रहणाद्विद्वन्मन्त्रं जलादिव्यहविरोधित्वम् । अवयवसन्निवेशाः

सत्तत्सामान्यविशेषाभिव्यञ्जकसंस्थानविशेषाः । न हि एतद्-  
द्रव्यान्तरे सम्भवति । जलादीनां यत्किञ्चित्स्य शब्दवेगवद्द्रव्यो-  
पनिपातमात्रेणैव भङ्गुरत्वात् । Udayana, Kiranāvali, *ibid.*

These original differences in molecular grouping leading to distinctions of genera and species, however mechanically or physically explained, come also under the operation of moral and metaphysical causes (अदृष्ट, कर्म), *i.e.*, of ideal ends in the moral government of the universe, which are superimposed upon the physical order, but which do not come within the scope of Natural philosophy. An elementary substance thus produced by primary atomic combination, may, however, suffer qualitative change under the influence of heat (पाकजातवृत्ति). The process is as follows:—(1) the impact of heat corpuscles decomposes the binary (tertiary, or quaternary) molecules into homogeneous atoms possessing only the generic characters of the Bhūta concerned;—(2) the impacts of heat particles continue, and transform the characters of the atoms, determining them all in the same way;—(3) the heat particles continue to impinge, and reunite the atoms so transformed to form binary (or other) molecules, in different orders or arrangements, which account for the specific characters or qualities finally produced. The Vaiseshika holds that

there is decomposition into homogeneous atoms, transformation of atomic qualities, and finally recombination, all under the influence of heat. The Nyáya on the other hand thinks that the molecules and larger aggregates assume the new characters under the influence of heat without decomposition into homogeneous atoms, or change of atomic characters ( पिठरपाक or पिठरपाक ).

तेषामनुमानेन विनाशः परिकल्पितः । सव्यावयवेषु अन्तर्बहिष्व  
पाकपूर्वकपूर्वकरूपादियिलक्षणगुणोपलब्धेरन्तःप्रवेशः कृशानो-  
रनुमीयते तेन वेगवता वह्निद्रव्येण नोदनात् अभिघातात् वा  
नूनं घटाद्यात्मकेषु अवयवेषु क्रिया जायते क्रियातो विभागः  
विभागात् द्रव्यारम्भकसंयोगविनाशः । तद्विनाशात् द्रव्य-  
विनाशः । पक्वाश्च श्यामादिगुणानवजङ्गतः रक्तादिगुणान्तर-  
योगमनुभवन्तः—अदृष्टप्रेर्यमाणाः परस्परं संयुज्य द्वयञ्च क्वादि-  
प्रक्रमेण तादृशमेव घटादिकार्यमारभन्ते । एवं तपनात्तपदृश्य-  
मानेषु, आम्नादिफलेषु, एष एव न्यायः । शरीरे अपि उदर्येण  
तेजसा पच्यमानेषु, अन्नपानादिषु, रसमलधातुभावेन परिणाम-  
मुपगच्छत्सु प्रायेण प्रतिक्रियामुत्पादविनाशौ संभवत इति ।  
( Jayanta, Nyáyamañjarí, भूततत्त्व-पूर्वपक्ष ). This is  
the Vaiseshika view, but Jayanta himself in-  
clines to the opposite view :—प्रकृतिसुषिरतवैव  
कार्यद्वयस्य घटादेः आरम्भात् अन्तस्तेजःसंश्लानुप्रवेशकृतपाकौ-  
पयन्तेः अजं विनाशकल्पनवा । पिठरपाकस्य एव प्रवेशः । *ibid.*  
The Nyáya view :—वे वीजावयवास्ते पूर्वव्यूहपरि-

that impinge on the atoms, or the nature of the impact (विचक्षणतेः-संयोगः). (न ब्रूयोज्ञाग्निः संयोगात् एकस्यात् रूपादय इति अपि तु पूर्वरूपादिविशेषापेक्षात् । यद्द्रव्यं पच्यते अग्निसंयोगेन तस्य ये पूर्वरूपादयस्तेषां यः स्वगतो विशेषस्तमपेक्षमाणाः अग्निसंयोगः उत्तरान् रूपादीन् विगिहानारभते । *Vide* also Udyotakara, III, 2, Sūtra 14. Cf. also Vāchaspati, I, 1, Sūtra 4. अस्माकमभेदे अपि उपादानस्य पिठरस्य औष्ण्यपराख्यस्य च वह्निसंयोगस्य पूर्वरूपादिप्रथ्वंसानां कार्यानां भेदात् भिन्नजातीया जायन्त गन्धरूपरसस्पर्शा इति सिद्धान्तः) ।

Now when the atoms have all been determined in the same way, they begin to recombine again under the impact (or impulse) of the heat-particles in binary molecules, (or tertiary, *etc.*), and these in higher aggregates. It seems to be generally held that, at the final step one or more atoms of one constituent substance unite with one or more atoms of the other constituent substance or substances to form a molecule of the com-

pound ; but the question is not of much significance for Mono-Bhautic compounds of the first order, as, in these cases, the atoms have before this all lost their distinctive characters and become homogeneously transformed. The compound so produced will possess the new characters of the transformed atoms, so far as taste, colour, smell, *etc.* are concerned, but as the molecular arrangement or structure (अणु, अवयवसन्निवेश) may vary, different compound substances may result from the same components.

- (b) Mono-Bhautic compounds of higher orders :—Again, Mono-Bhautic compounds of the first order may chemically combine to form higher compounds, and as the ultimate Bhúta substratum is the same, the process of decomposition and recombination will be essentially the same as before. The only doubtful point is whether in this case the component compound substances are broken up only into their constituent molecules, or into the original homogeneous Bhúta atoms. Some of the later Vaiseshika Scho-

liasts hold that the latter happens in every case of chemical composition, however complex, but the earlier Vaiseshika conceived that in the case of compounds of compounds, the decomposition does not proceed so far as the original Bhúta atoms ; but that it is the specifically determined atoms constituting the molecules of the component compounds that are transformed under the impact of the heat corpuscles ; and then one such transformed atom (one or more according to another version) from the molecule of one component unites with one similarly transformed atom ( one or more according to the other version) from the molecule of the other component. Prāsastapáda, the great Vaiseshika Doctor, holds this view. When, for example, in the fertilised ovum, the germ and the sperm substances, which, in the Vaiseshika view, are both isomeric modes of Earth ( with accompaniments of other Bhútas), unite, both are broken up into homogeneous Earth-atoms, and it is these that chemically combine under the animal heat ( and bio-motor

Energy, वायु ) to form the germ-plasm (कलस). But, next, when the germ-plasm develops, deriving its nutrition from the chyle (blood) of the mother, the animal heat breaks up the molecules of the germ-plasm into its constituent atoms (कलसारम्भक-परमाणवः), i.e., into atoms specifically determined, which by their grouping formed the germ-plasm, and then these germ-plasm atoms as radicals chemically combine with the atoms of the food constituents, and thus produce cells and tissues. (समुत्पन्नपाकजैः कलसारम्भकपरमाणुभिः अदृष्टवशात् उपजातक्रियैः आहारपरमाणुभिः सह सम्भूय शरीरान्तर-मारभ्यते इत्येषा कल्पना । पितुः शुक्रं मातुः शोणितं तयोः सन्निपातानन्तरं जठरानल-सम्बन्धात् शुक्रशोणितारम्भकेषु परमाणुषु पूर्वरूपादिविनाशे सति समानशुणान्तरोत्पत्तौ द्वयणुकादि-प्रक्रमेण कलसशरीरोत्पत्तिः । .....  
...तत्र मातुराहाररसः मातृया संक्रामति अदृष्टवशात् तत्र पुनर्जठरानलसम्बन्धात् कलसारम्भकपरमाणुषु क्रियाविभागादिन्यायेन कलस-शरीरे नष्टे समुत्पन्नपाकजैः कलसारम्भक-

परमाणुभिः चट्टवशात् उपजान्निवः आहार-  
 परमाणुभिः सह सम्भूय शरीरान्तरमारभ्यते  
 इत्येवा कल्पना । S'ridhara, Kandali,  
 ष्टिवीनिर्हणम् । ) In this hypothesis  
 ( कल्पना ), it is assumed that the  
 atoms are similarly transformed, *i.e.*,  
 become endowed with the colour,  
 taste, smell, *etc.* of the product ( the  
 cell or tissue ), the moment before  
 the chemical combination takes place.  
 Similarly, when milk is transformed  
 into curd, one view is that the trans-  
 formation takes place ( under internal  
 heat ) in the constituent atoms of  
 the milk molecules, atoms specifically  
 determined as milk, and not in the  
 original atoms of the Bhúta (or Bhútas)  
 entering into the composition of milk.  
 (Cf. एवं महादुग्धारन्मूत्रैः परमाणुभिरेव दध्या-  
 रभ्यते । एकमहिम्नैव दध्यान्मूत्रैरेव पर-  
 माणुभिर्नवनोत्पन्नैः इति दिक् । Nyāya-  
 bodhinī, on Annam Bhatta's Tarka-  
 saṅgraha. ) Cf. Dinakarī, on the other  
 hand—इत्युक्तं पदुग्धसंज्ञकत्वेऽपि तस्य  
 ( दध्नः ) । ) In these cases, the atomic  
 contact is called constituent contact

( कारन्धकसंयोग ), and all the atoms are equally regarded as material causes ( उपादानकारण or समवायिकारण ) of the compound.

- B. Hetero-Bhautic 'quasi-compounds'.—The Nyáya-Vaiseshika maintains that in the case of bi-Bhautic (or poly-Bhautic) compounds, which are only quasi-compounds, there is another kind of contact between the heterogeneous atoms of the different Bhútas, which may be called dynamic contact and is distinguished in its operations as Upashtambha, Vish/ambha or Avash/ambha (उपदम्भ, विदम्भ or अवदम्भ). In some cases, it so happens that the atoms of different isomeric modes of the same Bhúta do not chemically combine under the mere application of heat ;—they require to be surrounded (and 'excited', 'energised') by atoms of different Bhútas. For example, in the case of the oils and fats as well as of plant saps and fruit juices the Earth-atoms must be dissolved in water ( Ap ), and it is only when the water-atoms ( Ap-atoms ) congregate round the former that dynamic intra-atomic

forces are set up, and the Earth-atoms (with the water atoms in dynamic contact) now take on peculiar infra-sensible characters (colours, tastes, smells) under the impact of the heat corpuscles, and then, under further impact, fall into groupings or collocations (of a very peculiar nature, to be presently explained) which determine the nature of the composite substance thus produced. Here it is the water-atoms that are dynamic (उपहम्भक), and excite the Earth-atoms, and these substances, oils and fats (तैलवर्ग and घृतवर्ग), as well as acids (अम्लवर्ग) are, because of the Earth radicles regarded as Earth-compounds (or Earth-substances), (पाकज-तथाविधगन्धरसरूपादि-मद्भिः परमाणुभिर्द्रव्यैर्वादिभिरनेन घृतादिद्रव्य-मारभ्यते । तत्र च उपहम्भकतया निमित्तता-मापन्नाः पानीयावयवाः । तेषां संयुक्तसमवायेन स्नेहलज्जोपलभ्यते । तैलक्षीरादिषु पार्थिवत्व-शिद्धिः । तैलस्य भौमानुबन्धनत्वात् घृतवत् Udayana ). In the above instances, Ap (water) acts as dynamic (Upash-  
tambhaka, (उपहम्भक), but Tejas

and Váyu can also act in the same way on Earth-particles. Conversely, Earth-particles may act dynamically on the atoms of the other Bhútas. For example, in the case of mercury and the metals which are conceived in the Nyáya-Vaisesika to be igneous bodies (in fact they are supposed to be formed under the subterranean heat **आकरोज**), the Tejas corpuscles are believed to form the radicles, and the Earth-particles are dynamic (**उपटन्नाक**).  
 ( सुवर्णादि निरन्तरं भ्रमायमानमपि न पूर्वस्वरूपं जहाति । तेनैव दृवग्रान्तरेण प्रतिबद्धत्वात् उपटन्नाकेऽपि पार्थिवभागः सदृशरूप एवानु-  
 यत्तते, यत् पुटपाकादिना रक्तसारता दृश्यते तन्मिन्त्रीभूताभिभावकतत्तद्द्रव्योपगमात् ।  
 एतेन पारदादि यथाख्यातम् । Udayana, Kiranāvalī, तैजसि रूपणम् । Cf. also योऽपि तैजसमिच्छति सुवर्णं तेनाप्यत्र पार्थिवोभाग उपट-  
 न्नाक एव यः । )

It may be here noted that Gaṅgesa, the author of the *Tattvachintāmañi*, conjectures that even gold can be evaporated or made to disappear by the application of intense heat ;

अथ द्रुतद्रुततरादेः क्रमशः प्रतीतिः प्रबलानव-  
संदोगेन सुवर्धनायात् तद्द्रवता नश्यति । But  
Mathuránátha notes here—भक्ष्यप्राक्काशो-  
च्छेदकमवे । ( सन्निकर्षवाटरहस्य ) .

But while every Bhúta can act dyna-  
mically as उपदम्भक, 'energiser',  
'exciter', it is the Earth-Bhúta alone  
which is capable of exercising the  
power of arrest or inhibition of  
molecular motion or the motion of  
particles due to gravity as in fluids  
( Vishṭambha, विष्टम्भ ), or the power  
of counteracting the tendency in a  
given set of atoms to fall into a pe-  
culiar order or group ( व्यूहविरोधित्वम् ).  
( न च पार्थिववत् अग्नौ द्रव्यान्तरं गच्छद्विभक्ति-  
पूर्वव्यूहं वा विरुद्धि । Udayana, Kira-  
návalí, दृष्टिवीनिरूपणम् । विष्टम्भकत्वं स्वाभा-  
विकगुरुत्वाश्रयद्रव्यान्तरगतिप्रतिबन्धकत्वम् । व्यूह-  
विरोधित्वं च स्वाभाविकगुरुत्ववत्पतनप्रति-  
बन्धकत्वम् । Vardhamána, Kiranávalí-  
prakáśa, *ibid.* )

Oils fats, milks—Bi-bhautic quasi-compounds,  
with Ap as energiser :—Oleaginous substances

( **आज्यनैऋद्यः स्नेहाः** ) are divided by Udayana into (1) oils, derived from vegetables, (2) butters derived from milk, and (3) fats derived from animals. The medical schools, as we have seen, recognise animal oils as distinguished from vegetable oils. Vegetable fats ( *e.g.* **विडङ्गहृत** ) are also mentioned. Váchaspati in the *Tátparyyatíká* contends that mustard oil has not the flavour and smell characteristic of the true oils ( *sesamum, linseed etc.* ), and is classed with the latter by convention. Judged by the flavour test, **A'mikshá** (the casein substance formed by mixing milk-curd with hot boiled milk) is to be classed with milk substances. So also **Takra**, whey,—but **Vájina**, the thin fluid that is left after the **A'mikshá** (casein substance) is separated, cannot be classed as milk. It may be added that the milks and curds as well as oils and fats derived from different species of vegetables or animals are supposed to differ in their ultimate structural arrangement, and therefore in kind; but Vallabha thinks that the ghees (clarified butters) prepared from different kinds of milk are of the same kind; in other words, the milks and curds are 'polymeric', the ghees (clarified butters), 'isomeric', using these terms, as before, in a loose general sense.....**नैऋतवसानां वीजक्षीर-  
मांसमेतित्वात् । अतएव गारिबिलस्नेहस्यापि नैऋतं रसादि-**

सादृश्यादपि तु दृढव्यपदेशश्च । Udayana, Kiranāvalī, दृष्टिर्वाचनिरूपणम् । Vallabha notes that ghees do not differ in kind, as milks (and curds) do :— अतो माद्विषगव्यादिदुग्धेषु दधित्वत् एतादिषु जातिभेद-  
यवास्तामिति चेन्न ।—Vallabha, Līlāvatī. Compare Vāchaspati, II, 2, 65 :—आज्यतैलादीनां जातिस्तु गन्धेन वा रसेन वा व्यञ्ज्यते । अतएव न सार्वपादीनां तैलत्वमस्ति । तद्गन्धकयोगैर्वरसयोरभावात् । भाक्तस्तु तैलशब्दबोगः । क्षीर-  
जातिरपि रसव्यङ्ग्येव । अतएवाग्निचायाः क्षीरत्वम् । न तु वाजिनस्य तद्व्यङ्ग्यकस्य रसभेदस्य याजिने अभावात् आग्निचायां च भावात् ।

III. Mixtures like soups, solutions *etc.* :—A soup is a physical mixture. When meat is boiled in water, there is the application of heat, with chemical changes in the meat, but the combination of meat-particles and water-particles in the soup is only physical combination, and not a chemical one. It is of course not a true compound, neither is it a quasi-compound, like milk (in which the water-particles are 'energisers' of the Earth-particles). Milk, for example, retains its milky substance, when it coagulates or becomes solid, (this of course is also the case with mono-Bhautic substances whether elementary or compound, *e. g.* water, which becomes ice,) but the substance we call a soup or solution ceases to be a soup

or solution, the moment it solidifies. Udyotakara notices gruel, baths, and lyes (alkaline solutions) as mixtures of this class (एतेन पाककाञ्चिकविशेषावचारादयः प्रत्युक्ताः । Vārtika, Chap. I, A'hnika 1, Sūtra 14). यूषो हि नाम उत्पन्नपाकजानां द्रव्याणां कालविशेषानुपदे सति द्रव्यान्तरसंयुक्तानां पाकजातपत्तौ यः संयोगः स यूष इति । एतेन पाककाञ्चिकविशेषावचारादयः प्रत्युक्ताः । Udyotakara, Vārtika, Chap. I. A'hnika 1, Sūtra 14. *Vide* also Vāchaspati's comment : उत्पन्नपाकजानां तैस्ते सर्पिषि वा पिष्टमांसपिण्डावयवानां द्रव्यान्तरेण तोयेन संयुक्तानां पाकजातपत्तौ सत्यां न चासौ सहसा इत्युक्तं कालविशेषानुपदे सतीति । स च संयोगभेद-एव तोयमांसयोर्नतु अवयवी बिजानीययोरनारम्भकत्वात् । नापि दूषजातीयं तोयसंयोगि द्रव्यं क्षीरजातीयमिवेति युक्तम् । तोयविरहे । काठिन्येऽपि क्षीरबुद्ध्यपदेशयोस्तादवस्थयात् । इह तु काठिन्ये न दूषबुद्ध्यपदेशो इति सम्बन्धभेद एव तोयमांसयोर्बुध इति न्याय्यम् । स च अनुभवसिद्धः संयोग-व्यतिरिक्तः । Vāchaspati, Tātparyyatīkā, *ibid.* For salt and alkaline solutions, *vide* Kiranāvalī—यत् पुनरनुधिसिन्धुभेदेन चारादिरपि रसः पादसे उत्पन्नभ्यने स दशमूलकपायसेऽव पार्थिवद्रव्योपार्थिकः । कश्चनन्यथा तसेऽव घनपीतमुक्तस्य रसो मधुर एव । Udayana, Kiranāvalī, जलानिरूपणम् ।

Chemical action and Heat :—The operation of heat is of course universally implied in chemical

combinations. Where the application of external heat is wanting, Vátsyáyana, the great Doctor of the Nyáya, points to the operation of internal heat.

(*e.g.* दृष्टिबोधात्: अवधातुना संवृद्धीतः आन्तरेण तेजसा पच्यमानः रसद्वयं निवर्त्तयति ।—Vátsyáyana-Bhášhya, Chap. IV, Áhniká 1, Súra 47 ). In the case of combustion, we have seen Vijñána-bhikshu explain the heat as latent in the Earth-substance, the fuel, from which it breaks forth. Udayana points out that the solar heat is the source of all the stores of heat required for chemical change in the world. The change of colours in grasses, for example, is due to Tejas, in the form of latent (invisible) heat, not in the form of Agni; and the cold in winter cannot take away this store derived from the Sun. (तृणादिविकारो हि यदि रूपादिपरावृत्तिमात्रहेतुः स नूनमौष्णप्रापेक्षेण तेजसा कर्त्तव्यः । तादृशं च पाके अग्निमित्तं हि भवति । न किञ्चिदनिष्टमापद्यते । न हि सौदस्य तेजसः त्वौष्ण्यपाकहेतोर्हिमादपगमः क्षमते । अथ विकारो भस्मादिरूपो विवक्षितः सोऽसिद्ध एव हि महत्तु तृणादिषु कं विरोधो बाधो वा । अथ रूपादिपरावृत्तिमात्रेणैव अग्निः साध्यते तदशक्यम् । तस्य दर्शनस्पर्शनयादृशस्य अवधारणया बाधितत्वात् अतादृशस्य तेजोमात्रस्य निवृत्तेरशक्यत्वात् अनिष्टत्वात् च । Udayana, Kiranávali दृष्टिसंहारविधिनिरूपणम् ।) Similarly, it is under this solar heat that the unripe mango ripens, *i.e.* changes

colour, taste, smell *etc.*, showing that there is chemical transformation or subtile decomposition and recomposition going on ; and this is also the case with the rusting of the metals, which is a combustion due to the solar heat ( सूर्य पाक ) even as the conversion of food into chyles and of chyle into blood are instances of chemical action due to the internal animal heat ( जठरानल or औदर्य तेजः ). But the kind of contact with heat-corpuscles, in other words, the kind of chemical action ( पाक ) which transforms colours is supposed to differ from that which transforms flavour *etc.* ( विलक्षणतेजःसंयोग and पाक ) and this last from that which produces a change of smell, or tactile quality. ( पाको नाम विजातीयतेजःसंयोगः । स च नानाजातीयः । रूपजनको विजातीयतेजःसंयोगस्तदपेक्षया रसजनको विजातीयः । एवं स्पर्शादौ अपि तथा । एवं प्रकारेण भिन्नभिन्नजातीयाः पाकाः कार्यवैलक्षण्येन कल्पनीयाः । तथाहि तृणपुष्पनिष्पिप्पा-  
 २म्बादौ सण्णलक्षणविजातीयतेजःसंयोगात् पूर्वहरितरूपनाश रूपान्तरस्य पीतादेरुत्पत्तिः पूर्वरसस्य अमृतसैत्रवानुभवात् । क्वचित् पूर्वहरितरूपसत्त्वेऽपि रसपरावृत्तिर्दृश्यते विजातीय-  
 तेजःसंयोगरूपपाकवशात् पूर्वतनास्वरसनाशे मधुररसस्यानु-  
 भवात् । तस्माद्रूपजनकापेक्षया रसजनको विलक्षण एवं गन्धजनको विलक्षण एवाङ्गीकार्यः । एतद्वद्वत्परावृत्तौ अपि पूर्वगन्धनाशे विजातीयपाकवशात् सुदभिगन्धोपलब्धेः । एवं

स्पर्शजनकोऽपि पाकवशात् कठिनस्पर्शनाशे तदुत्पत्त्यानुभवात् ।  
 अतएव पार्थिवपरमाणूनामेकजातीयत्वेऽपि पाकमहिम्ना  
 विजातीयद्रव्यान्तरानुभवः । यथा गोमुक्तदद्यादीनां आपर-  
 माण्वन्तं भङ्गे दद्यारम्भकपरमाणुषु विजातीयतेजःसंयोगवशात्  
 पूर्ववद्रूपादिचतुष्टयनाशे तदनन्तरं दुग्धे यादृशं रूपादिकं वर्तते  
 तादृशरूपरसगन्धस्पर्शजनकास्तेजःसंयोगा जायन्ते । तदुत्तरं  
 तादृशरूपादय एव पद्यन्ते । तादृशरूपादिविशिष्टपरमाणुभि-  
 र्दुग्धद्रव्यकमारभ्यते । ततः त्वणुकादिक्रमेण महादुग्धारम्भ-  
 इति । Nyāyabodhini on Annam Bhatta's Tarka-  
 saṅgraha ). Heat and light rays are supposed to  
 consist of indefinitely small particles which dart  
 forth or radiate in all directions rectilineally with a  
 sort of conical dispersion and with inconceivable  
 velocity. They may either (1) penetrate through  
 inter-atomic (or inter-molecular) spaces as in cases  
 of conduction of heat which when applied under  
 the pot boils the water, or fries the paddy where  
 there is no chemical action in the pot, no decom-  
 position and recombination of its atoms, no change  
 in the molecular collocation; or, as with light  
 rays in cases of translucency or transparency  
 (स्पर्शना) penetrate through the inter-atomic spaces  
 with Parispanda of the nature of deflection or  
 refraction (तिथ्यगमन, Udyotakara), in the same  
 way as when fluids penetrate through porous bodies  
 (तत्र परिस्पन्दः तिथ्यगमनं परिस्पन्दः प्राप्त इति—Udyo-

takara, commenting on Vātsyāyana's परिस्सन्द-परिस्सवौ, Sūtra 47, A'hnika 1, Chap. III.) or (2) impinge on the atoms, and rebound back—which explains reflection ( घूर्णन, किरणविघटन—Varāhamihira, रश्मिपरावर्तन—Vātsyāyana ) or otherwise be obstructed by the atoms in their path, which would explain degrees of opacity, the casting of shadows, *etc.*, all these operations being also physical, and unattended with decomposition and recombination or alteration of molecular grouping, or (3) lastly, strike the atoms in a peculiar way, so as to break up their grouping, transform the physico-chemical characters of the atoms, and again recombine them, all by means of continual impact with inconceivable velocity, an operation which explains all cases of chemical combination. (अचिन्त्यो हि तेजसो लावघातिशयेन वेगातिशयः यत् प्राचीना-चक्षुःश्रोत्रावहस्त्रिण एव भगवति मयूखमास्त्रिण भवनोदरेषु व्यासोक्तवत्याभिमानी लौकिकानाम् । (Udayana, Kiranāvalī, तेजोनिरूपणम्—taken from Vāchaspati, Tātparyya-tīkā, प्रत्यक्षवक्ष्यस्तत्त्वम् ।) Cf. also ( चाक्षुर्षं तेजः वेगवता सावित्नेन तेजसा न प्रतिहृत्यते । Vāchaspati—वर्त्ति देशे पिबिहृतमपि तेजः प्रसपेत् प्रासादोदयं व्याप्नोति । तत् कस्य हेतोः पृथग्रपत्वात् । स्वभावतः प्रसरदपि न स्वपरि-माणानुविधाविनं प्रत्यवभाषते किं तु विषयभेदानुविधाविनम् । *ibid.* Cf. स्फटिकाद्यन्तरिनोपलब्धिरपि प्रसादस्वभावतया

स्फटिकादीनां तेजोगते ~~स्फटिक~~ कतया प्रदीपप्रभावादेवोपपन्ना ।

Udayana, तेजोनिरूपणम्, in reply to the objection—

यदि हि प्राग् स्फटिवात् प्रतिघातिना स्फटिकद्रव्येण विटम्भा-  
दप्राप्तं प्रसर्पस्तत्कटिकं नाददीत तस्मादप्राप्यकारि ततो न  
तेजसम् । (Udayana, *ibid.*) Definition of स्फटिकता—

द्रव्यान्तरासम्पृक्तद्रव्यसमवायः स्फटिकता । इष्टत्वाप्रतीधानः काचान्-  
पटलस्फटिकान्तरितोपलब्धेः ।..... स्थाव्यादिषु च पाचकस्य

तेजसोऽप्रतीधानात् । Udyotakara, Chap. III, A'hnikā

1, Sūtra 38. आदित्यरश्मेः स्फटिकान्तरितेऽपि दाहेऽवि-  
धानात् । Sūtra 47, where Udyotakara notes—कोट्य-

मविधानः—यस्य द्रव्यस्यावयवा न व्यूहग्रन्थे तस्य अन्तरावयवैः  
अव्यूहग्रन्थेन सौमिसम्बन्धः सौमविधान इति । Vāchaspati

explains यस्य द्रव्यस्य भर्जनकपालादेः अवयवा न व्यूहग्रन्थे  
पूर्वोत्पन्नद्रव्यारम्भकसंबोगनाशेन द्रव्यान्तरजनकसंबोगोत्पादनं

व्यूहनं तत्र क्रियन्ते तस्य द्रव्यस्य भर्जनकपालादेरव्यूहग्रन्थेन  
अन्तरावयवैर्बोमिसम्बन्धो बह्वैः सौमप्रतिधानः । Cf. Vātsyā-

yana on Sūtra 47, A'hnikā 1, Chap. III. On the  
other hand in chemical combination, अन्तःप्रवेशः

कथानोरनुमीयते । तेन वेगवता वस्त्रद्रव्येण मोटनात् अभि-  
धानात् वा अथ येषु क्रिया, क्रियातो विभागः, विभागात्

आरम्भकसंबोगविनाशः *etc.*—Jayanta, Mañjarī, भूतचैतन्य-  
पूर्वमथ । For opacity, shadows, *etc.*, *vide* छाया ह

तेजःपरमाकोरावरणात् भूर्निमता परमाणुना तेजःपरमाणु-  
राजिवते । यत्र च अस्य आवरणं तत्र छायेति । विरह-

तेजःसम्बन्धीनि वस्तुसम्बन्धीनि च ज्ञाया इत्यभिधीयते । सम्बन्धो  
 व्यावृत्ततेजःसम्बन्धीनि तु तानि तलःसंज्ञकानि । Udyotakara,  
 Chap. IV. Áhnika 2, Sútra 25. For reflection,  
 and its laws, I quote passages in my paper  
 on Hindu Physics and Mechanics, to which  
 the student of the history of Optics is referred.

Arrangement of atoms in Space :—The Nyáya  
 conceives atomic magnitudes as *Párimándalya*, a  
 term which indicates a spherical shape. (नित्यं परि-  
 मण्डलम्—परिमण्डलमेव पारिमाण्डल्यम्—Saṅkaramisra).  
 To conceive position in space, Váchaspati takes  
 three axes, one proceeding from the point of sunrise  
 in the horizon to that of sunset on any particular  
 day ), ( roughly speaking, from the East to the  
 West);—a second bisecting this line at right angles  
 on the horizontal plane, ( roughly speaking, from  
 the North to the South ), and the third proceeding  
 from the point of their section up to the meri-  
 dian position of the sun on that day, ( roughly  
 speaking, up and down ). The position of any  
 point in Space, relatively to another point, may  
 now be given by measuring distances along these  
 three directions, *i. e.* by arranging in a numerical  
 series the intervening points of contact, the less  
 magnitude or distance being that which comes ear-  
 lier in this series, and the greater that which comes  
 later. The position of any single atom in Space  
 with reference to another may be indicated in this

way with reference to the three axes. But this gives only a geometrical analysis of the conception of three-dimensioned Space, though it must be admitted in all fairness that by dint of clear thinking it anticipates in a rudimentary manner not only the foundations of solid (co-ordinate) geometry, but also of the geometry of position, and especially the conception of Space as a Manifold, which alone can serve as the basis of a generalisation comprehending all different possible kinds of geometry, Euclidean and non-Euclidean.

(एकत्वेऽपि दिशः आदित्योदयदेशप्रत्यासन्नदेशसंयुक्तौ यः स इतरस्याद्विप्रकटप्रदेशसंयोगात् परमाणोः पूर्वः एवमादित्यास्तमयदेशप्रत्यासन्नदेशसंयुक्तौ यः स इतरस्याद्विप्रकटप्रदेशसंयोगात् परमाणोः पश्चिमः तौ च पूर्वपश्चिमौ परमाणौ अपेक्ष्य यः सूर्योदयास्तमयदेशविप्रकटप्रदेशसंयोगः स मध्यवर्ती । एवमेतयोर्दौ तिर्यग्देशसम्बन्धिनां मध्यस्य आर्जवेन व्यवस्थितौ पार्श्ववर्त्तिनौ तौ दक्षिणोत्तरौ परमाणौ । एवं मध्यन्दिनवर्त्तिसूर्यसन्निकर्षविप्रकर्षौ अदेक्ष्य उपर्यधोभावो द्रष्टव्यः । संयुक्तसंयोगात्पत्वभूयस्त्वे च सन्निकर्षविप्रकर्षौ पूर्वसंख्यावाच्यत्वं च अक्षपत्वं परसंख्यावाच्यत्वं च भूयस्त्वम् ।  
Vāchaspati, Tātparyyatikā, Chap. IV. A'hnikā 2, Sūtra 25.

The original physical arrangement of atoms is also given. Each atom is in contact with six other atoms, which gives a cubical arrangement. एवं

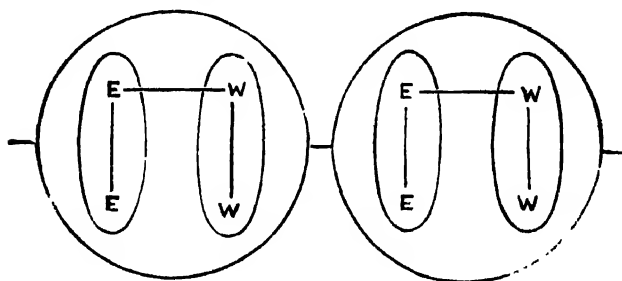
दिशोऽपि एकस्या अपि बंधोऽगः एव भागाः स्यात्वं परमाणोः  
 षट्कोन युगपद्बंधोऽगः सूक्ष्मत्वमात्रप्रयुक्तः न सावयवत्वप्रयुक्तः । *ibid.*  
 Cf. also the objection in the Buddhist Kārikā.  
 षट्कोन युगपद्बंधोऽगः परमाणोः षड्भेदाः । षड्भां समानदेशत्वे  
 पिण्डः सप्तादयुमात्रकः ॥ This is the typical primordial  
 arrangement, and variations in the collocation  
 of atoms and molecules (यद्रूप, अवयवसंनिवेश), as  
 we have seen, were conceived to account for  
 the variety of isomeric modes of the same Bhūta,  
 as well as of mono-Bhautic and poly-Bhautic  
 compounds.

The molecular arrangement in the case of  
 Li-Bhautic compounds is very peculiar. Two sub-  
 stances, say Earth and Ap (water), form a quasi-  
 compound, first, and each substance breaks up  
 into atoms, one atom of Earth comes into contact  
 with one of Ap. But the two do not form a binary  
 molecule. Instead, this contact of heterogeneous  
 atoms leads to a curious result. The atom of Earth  
 combines with a neighbouring atom of its own class,  
 and forms a binary molecule. Simultaneously  
 the atom of Ap combines with another Ap-atom,  
 and forms a binary molecule. Now the first binary  
 molecule links on to the atom of Ap, and  
 similarly the second binary molecule links  
 on to the atom of Earth. The moment after,  
 the two binary molecules take on the physico-

chemical characters of Earth and Ap respectively, and simultaneously with the assumption of these physico-chemical characters, the binary molecules enter into complex contact (संयोगज संयोग). In all this process, work is done only in the first instant, in the contact of an atom of Earth with one of Ap—the resulting contacts, of atom with binary molecule and of the binary molecules with each other, involve no further expenditure of Energy. Thus we get a particle holding two binary molecules (of Earth and Ap respectively) in complex contact, and such particles continue to be formed. In this way the particles of the two substances arrange themselves, and the peculiarity of this molecular arrangement explains the resulting mixed or compound qualities of this class of quasi-compounds. (संयोगजस्तु (संयोगः) उत्तमपद्मनाभस्य चिरोत्पन्नस्य वा निष्क्रियस्य कारणसंयोगिकारणैः कारणाकारणसंयोगपूर्वकैः कार्याकार्यगतैः संयोगः ।..... एकस्माद् द्वयोस्तत्पत्तिः । अथम् । यदा पार्थिववाय्वोरख्योः संयोगे सति अन्येन पार्थिवेन पार्थिवस्य अन्येन वाय्वेन च वाय्वस्य युगपत्संयोगो भवतस्तदा ताभ्यां संयोगाभ्यां पार्थिववाय्वे द्वययुक्ते युगपदारभ्यते । ततो यस्मिन् काले द्वययुक्तयोः कारणयुगपूर्वक्रमेण रूपाद्युत्पत्तिः तस्मिन्नेव काले इतरेतरकारणाकारणगतात् संयोगात् इतरेतरकार्याकार्यगतौ संयोगौ युगपदुत्पद्येते । किं कारणम् । कारणसंयोगिना

हि अकारणेन कार्यं अशक्यं संयुज्यते इति न्यायः ।  
 पार्थिवं द्वाणुकं कारणसंयोगिना आग्नेन अणुना सम्बध्यते ।  
 आग्नेमपि द्वाणुकं कारणसंयोगिना पार्थिवेनेति ( Prasasta-  
 pāda-Bhāshya, गुणचन्द्र संयोगनिरूपणम् ।)

The whole process may be graphically re-  
 presented as follows :—



E = an atom of Earth.

W = an atom of water (Ap).

E  
|  
E = a binary molecule  
of Earth.

W  
|  
W = a binary molecule  
of water (Ap).

Molecules of a bi-  
 Bhautic quasi-com-  
 pound ;—graphic for-  
 mula of complex  
 contact.

I will conclude this account of ancient (and mediæval) Hindu chemistry with a note on the conception of molecular (atomic) motion, Parispanda, and the different varieties of such motion which were conceived to account for the physical phenomena of sound, light and heat. Any attempt to differentiate rigidly between Mechanics and

Physics on the one hand and Chemistry on the other at this primitive stage would be an idle affectation. My paper on Hindu Mechanics and Physics will give a detailed exposition in a separate treatise.

**Parispanda :—**Resolution of all physical action into motion :—

Parispanda sometimes stands for motion molar as well as molecular, but more often for the subtile motion of atoms or molecules. The radical meaning of the term is whirling or rotary motion, a circling motion, but it may also include simple harmonic motion (*e. g.* vibration). All action, operation, work (क्रिया, व्यापार) is ultimately traced to this form of subtile motion lodged in the atoms or in the matter-stuff. The Vedánta, for example, speaks of a cosmic vibratory motion (सर्वलोक-परिखण्डनम्—Saṅkara).—Ā́kāśa, in the Vedánta, as we have seen, is the first stadium in the evolution of Matter, which gives off Váyu, which gives off Tejas, and so on ; but Ā́kāśa (Ether) itself passes through two stages before the emanation of the Sūkshmaabhúta Váyu :—(1) the motionless ubiquitous primordial matter-stuff (answering to the Sāṅkhya Bhútádi) called Purāṇam kham (पुराणं खं); and (2) a subtile integration, the pure unquintuplicated Sūkshmaabhúta called Váyuram Kham

(वायुरं खं) (answering to the Sāṅkhya Tanmātra stage). It is this subtle Ākāśa, in its Tanmātric integration, *i. e.* in the derivative form, which is subject to an incessant Parispanda. The gaseous stage of matter (the Vedāntic Vāyu) is indeed matter in a state of Parispandic motion (वायोः परिस्यन्दात्मकत्वात्—Sāṅkara). So also the bio-motor and sensori-motor principles apart from the directive Intelligence of the Self (प्रणस्य परिस्यन्दात्मकत्वादेव—यद्वै तन्मू स्तू नं तू त्सञ्च ततसञ्च मनःस्यन्दितमात्मम्—Sāṅkara). The Sāṅkhya also conceives this Parispanda to characterise every process and phenomenon of cosmic evolution (व्यक्तं सक्रियं परिस्यन्दवत्—Vāchaspati, Kaumudī). Bhūtas, organisms, mental organs, as modes of Prakṛiti (considered apart from the Intelligence of Puruṣa) are all subject to this Parispanda (बुद्ध्यादयो देहं त्यजन्ते देहान्तरं उपाददन्ते इति तेषां परिस्यन्दः। शरीरवृत्तिप्रदीनां च परिस्यन्दः प्रसिद्ध एव।—Vāchaspati on Kārikā 10). On the other hand, Prakṛiti as the Avyakta, the a-cosmic, the un-manifest ground, with resolution only of like to like (सदृशपरिणाम), is devoid of all Parispandic motion (यद्यपि अव्यक्तस्यापि परिणामसञ्चयक्रिया, तथापि परिस्यन्दो नास्ति। *ibid.* on Kārikā 10). The Nyāya-Vaiśeṣika finds Parispanda in all

forms of matter, except A'kása which, in that system, is non-atomic and incapable of any change or activity ( निष्क्रिय ). But all atoms from those of Váyu downwards, are in incessant motion. The world at bottom is an infinitude of continually whirling ( or vibratory ) particles ( अनवरतपरिस्फुटमानापरिमितपदमादिपरमाणवः—Raghunátha ;—compare also Udayana-Kusumáñjali, Stavaka V.—परमाणवः हि गतिशीलत्वात् पतनव्यपदेशाः पतन्तीति । ). All physical action consists in motion. The Nyáya-Vaisheshika rejects force, power, operation ( शक्ति ) except as modes of motion. Jayanta indeed states we do not acknowledge any mysterious power or operation, which the senses do not and cannot report to us. But this denial of Force ( शक्ति ) and of unperceived and unperceivable operation ( अतीन्द्रियव्यापार ) is put forward as a philosophical ( epistemological and metaphysical ) proposition to justify the Nyáya analysis of the causal *nexus* into mere invariable and unconditional antecedence among phenomena without productive power or efficiency ( अन्यथानिर्दिष्टन्यस्य नियतपूर्ववर्तिता—Bhášhá-Parichchheda ). It is not of course intended to question the existence of Parispanda, which is of the nature of motion, and which, though subtile and therefore infra-sensible ( सूक्ष्म and अनुकूलरूप, not अतीन्द्रिय ), is the ultimate form of all physical

activity. (परिस्सन्द एव भौतिको व्यापारः करोत्यर्थः । ज्ञानी-  
न्द्रियस्तु व्यापारः नास्तीति ब्रूमहे ।.....तस्मात् कारक-  
चक्रेण चक्षुषा जन्यते फलम् । न पुनश्चक्षुषादन्यो व्यापार-  
उपपद्यते । Jayanta, Nyáya-Mañjarí, Áhnika I ).  
The effect (no less than the action) is, in all cases of  
material causation, the resultant of the combined  
motions of the various ( material and efficient )  
causes involved ( *c. g.* in the case of पाक-समुद्दिन-  
देवदत्तादिककलकारकनिकरपरिस्सन्द एव विशिष्टफलावच्छिन्नः  
पाक इत्युच्यते । ... अथ व्यापार एवैषः सर्वः संभूय साध्यते ।  
किं फलेनापराद्धं वः तद्धि संभूय साध्यताम् ।—Jayanta,  
Nyáya-mañjarí, Áhnika I ).

But, in the Nyáya-Vaisesika, though all action  
of matter on matter is thus resolved into motion,  
conscious activity is sharply distinguished from all  
forms of motion, as against the Sāṅkhya-Vedānta,  
which, as we have seen, considered every thing  
other than Intelligence, the Purusha or the trans-  
cendental Self, to arise in the course of cosmic  
Evolution, and therefore to be subject to Parispan-  
dic motion. ( क्रियाविशेष एवार्थं व्यापारो ज्ञातुरान्तरः ।  
स्यन्दात्मकवह्निर्भूतक्रियावज्जगद्विलक्षणः ।—Quoted in Jay-  
anta's Nyáya-mañjarí, Áhnika IV ).

Santána, *i.e.* Gati-santána (including wave  
motion and current motion or convection ); Kampa  
santána, Spandana, ( vibration ) :—Charaka notes

three kinds of *santánas*, serial motions, *vis.*, those of water, sound and light ( जलसन्तान, शब्दसन्तान and अक्षिःसन्तान ). Chakrapáni points out that a wave of sound travels more rapidly than a wave of water, and much less rapidly than a ray of light. In Hindu Mechanics, a current of water (downward flow, स्थन्दन) is conceived to consist of particles moving in an uninterrupted series under the action of gravity and fluidity ( गुरुत्व and द्रवत्व ). A ray of light implies the rectilinear propagation of indefinitely minute corpuscles, in all directions, with inconceivable velocity, and a sort of conical dispersion ( अचिन्त्यो हि वेगतिष्ठयः तेजःप्रसर्पन् व्याप्नोति पृथ्व्यत्वात् Udyotakara—Váchaspati ). A wave of water ( वीचि-तरङ्ग ) implies the transmission of vibratory motion in the water particles. ( Cf. Jayanta—पतद्ब्रजनपयोबिन्दु-संदोहस्थन्दनक्रमात्, Áhnika II ) A wave of sound is conceived by some on the analogy of a wave of water ( वीचितरङ्गन्याय ), only the air-waves ( cf. the *Mímámsá* ) or the sound-waves in and through the vehicle of air-waves ( cf. the *Nyáya-Vaiseshika* ) travel by concentric circles not in one but in all planes. ( N. B. this assumes transverse waves ). Others hold that the air-waves ( cf. the *Vákya-pádiya* ) or the sound-and-air waves ( cf. Udyotakara ) are propagated by the transmission of the vibration in all directions, leading to conjunction and disjunction of air-particles, so that the wave may be said to expand by alternate concentric

spherical layers of rarefaction and condensation (प्रचय. ( N. B. this assumes longitudinal waves ),— ( कदम्बगोखलन्याय—cf. संयोगविभागा नैरन्तर्येण क्रियमाणाः शब्दमभिव्यञ्जन्तो नादशब्दवाच्याः (Savara-Bhāshya 1-1-17) अभिघातेन हि प्रेरिता वायवः क्षिप्तानि वायुन्तराणि प्रति धावमानाः सर्वतोदिक्कान् संयोगविभागान् उत्पादयन्ति ।—*ibid.* 1-1-13 ) The Vākya-pādiya describes articulate sounds (Varnas) and indeed all sounds (śabdās) as only forms of air set in motion, with rarefaction and condensation (प्रचय), and capable of variations of velocity and configuration (स्थानेष्वभिहतो वायुः शब्दत्वं प्रतिपद्यते । तस्य कारणमामर्त्यात वेगप्रचयधर्म्मिणः । संनिपातान् विभज्यन्ते सात्वत्योऽपि मूर्त्तयः—Vākya-pādiya, Kānda I. Sloka 109 ) (*vide* my paper on Hindu Mechanics and Physics ). ( For the Hindu doctrine of scientific Method, *vide* Appendix ; for certain interesting recipes of chemical technology, *vide* Addenda ).

I had intended to conclude this survey of Hindu Physico-chemical science with a comparative estimate of the evolution of scientific ideas in the culture-history ( kultur-geschichte ) of the Chinese, the Greeks and the Arabs, as an Essay in the historico-comparative method of investigation ( *vide* the Preface to my Comparative studies in Vaishnavism and Christianity for a correction of this method ), but space forbids, and the reader too, I fancy.

## The Date of Rasaratnasamuchchaya.

While the present volume was about to issue from the press, Mr. T. G. Kála, Editor of the Marhattá Journal "Samálochaka", sent us a critical notice of R. R. S. As there are some important historical facts brought to light and as the date of this work arrived at from quite independent sources tallies with that assigned by us (Vol. I. Intro. LXXXIX), we make no apology for reproducing its substance in a condensed form.

Charpaṭi or Charpaṭinátha of the Nátha school is mentioned in the R. R. S., (see VI, 58, Poona edition), as also king Singhana.

The Navanátha Saktisára, a Marhattá work by Narahari Mála, gives some legendary information about this Charpaṭinátha and speaks of him as a contemporary of Matsyendranátha. On the left has

मत्सेन्द्रनाथ

गोरक्षनाथ

गैनीनाथ

निवृत्तिनाथ

ज्ञानदेव

i.e., A. D. 1290. So मत्सेन्द्र and Charpaṭinátha must have lived at the *beginning of the thirteenth century A. D.*

been given the geneology of the pupils of मत्सेन्द्रनाथ. The last, ज्ञानदेव or ज्ञानेश्वर, was the celebrated Marhattá Saint and author of a commentary on the भगवद्गीता called ज्ञानेश्वरी.\* It was written in Saka 1212,

\* See the concluding portion of ज्ञानेश्वरी, a Marhatta' work.

The R. R. S. which mentions the Siddha Charpaṭi must be therefore later than the first half of the thirteenth century A. D.

सेवयचन्द्र II (A.D. 1069

सिंघा I

मल्लुगि

भिल्लम (A. D. 1191)

जैभपाल (A. D. 1191-210)

सिंघा II (A.D. 1210-1247) Among the Yādava kings of Devagiri or Daulatābād, there were two kings by the name of Singhana. Taking the Singhana mentioned by R. R. S. to be the second, we are required to place the composition of the work in the latter half of the 13th century. On the whole, the R. R. S. may be safely taken to be a work written *about 1300 A. D.*

## THE WEIGHT OF AIR.

(By Principal B. N. Seal).

Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e.g.*, metallurgy, dyeing, pharmacy, perfumery, cosmetics, horticulture, and the making of glass (lenses and mirrors of various kinds are mentioned, the spherical, oval—*वृत्त* and *वर्तुल*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). But of Experiment as a Scientific method of Proof or Discovery, the instances are rare. I may note one

interesting example in Udayana's *Kiraṇāvalī*, relating to the weight of air. Udayana argues that air must be a distinct and independent *Bhūta*, for if air were made of the Earth-*Bhūta*, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, घूम ) rises in the air, whereas air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (gas, घूम ) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes, at least as applied to gases. Vallabhāchāryya in the *Lilāvati* speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float or to come up to the surface of the water but the description shows that he had no clear ideas on the subject. Cf. Udayana, *Kiraṇāvalī*, वायुनिष्पन्नम् । Cf. also Vallabhāchāryya, *Lilāvati*.

## APPENDIX.

### *On the Scientific Method of the Hindus.*

( BY PRINCIPAL BRAJENDRANATH SEAL. )

The Doctrine of Scientific Method :—A study of the Hindu Methodology of Science is absolutely essential to a right understanding of Hindu positive Science, its strength and its weakness, its range and its limitations. Apart from this rigorous Scientific Method, Hindu Chemistry, such as it is, would be all practical recipe, or all unverified speculation. This, however, would be a very inadequate and indeed erroneous view of this early achievement of the human mind. That the whole movement was genuinely and *positively* scientific, though arrested at an early stage, will appear from the following brief synopsis of the Hindu Methodology of Science.

Criterion or Test of Truth :—The ultimate Criterion of Truth is found not in mere cognitive presentation, but in the correspondence between the cognitive and the practical activity of the self, which together are supposed to form the circuit of consciousness. That knowledge is valid which prompts an activity ending in fruition. (Cf. the distinction between *सम्बन्धादिज्ञान* and *विसम्बन्धादिज्ञान* । Also; *प्रमाचतोऽर्धप्रतिपत्तौ प्रवृत्तिज्ञानार्थात् चर्चवत् प्रमाचम्—Vātsyāyana*).

Truth is *not* self-evidence, *not* the agreement between ideas, *nor* the agreement of the idea with the reality beyond, for this cannot be attained direct, but the harmony of experience (सन्नाद), which is implied when the volitional reaction, that is prompted by a cognition and that completes the circuit of consciousness, meets with fruition, *i. e.*, realises its immediate end (cf. Sriharsha, Khandana Khanda Khádyá on the relation of प्रमा to लोकाव्यवहार). This is the material aspect of Truth. The formal aspect is given in a principle which governs all presentations in consciousness, and which combines the three moments of Identity, non-Contradiction and Excluded Middle in every individual cognitive operation [तदन्तर्गतं परिच्छिन्नमिति (identity) अन्वयः व्यवच्छिन्नमिति (non-contradiction) तृतीय-प्रकाराभावं च सूचयति (excluded middle) इति एकप्रमाणा-व्यापारः—Jayanta, Nyáya-Manjarí, प्रमाणादौ विध्यलक्षणम्].

Perception :—The conditions of perception, and its range and limits, were carefully studied. The minima sensible (*c.g.*, the minimum visible, the Trasarenu, the just perceptible mote in the slanting sunbeam), the infra-sensible (अनुदृशक्यं सूक्ष्म, sometimes termed अतीन्द्रिय), the obscured (अभिभूत, *c.g.*, a meteor in the mid-day blaze), and the potential (अनदृशक्यं), are distinguished; but finer instruments of measurement were wanting, and this was a principal cause of arrested progress. It may be noted that the measurement of the relative pitch of

musical tones was remarkably accurate and original (*vide* my Paper on Hindu Mechanics and Physics).

Observation (वचस्पति—Váchaspati and Udayana):—

The entire apparatus of scientific method proceeded on the basis of observed instances carefully analysed and sifted. This was the source of the physico-chemical theories and classifications, but in Anatomy, the Hindus went one step further; they practised dissection on dead bodies for purposes of demonstration. Ingenious directions are given, *e. g.*, the body must be first disembowelled and wrapped round with the kusa and other grasses, then kept immersed in still water for seven days, after which the medical student should proceed to remove the layers of the skin with a carefully prepared brush made of the fresh elastic fibres of green bamboos;—which will enable the tissues, vessels and ducts to be observed. *Post-mortem* operations as well as major operations in obstetric surgery (the extraction of the foetus, etc.) were availed of for embryological observations (*e. g.*, it is stated as a result of observation that the rudiments of the head and the limbs begin to appear in the foetus in the third month, and are developed in the fourth; the bones, ligaments, nails, hair, etc. becoming distinct in the sixth);—and also embryological theories, *e. g.*, the indication of sexual character in the second month by the shape of the foetus, the shape of a round joint indicating the male sex, and an

*elongated* shape as of a muscle the female sex (cf. Charaka, Sutrasthāna, Chap. IV,—द्वितीये मासि चनः सप्तम्यते ऽपि पेश्यन्ते वा । तत्र चनः पिष्टः पुरुषः स्त्री पेशी चर्बुदं नपुंसकम् । Chakrapāni notes : चनः कठिनः । पिष्टो रज्याकारः । पेशी दीर्घमांसपेक्षाकारः । चर्बुदं वर्तलोन्नतम् loc. cit. ). In Phonetics (as in the Prātisākhyas, circa 600 B. C.), in Descriptive and Analytical Grammar (as in Pānini ), and in some important respects in Comparative Grammar (as in Chanda's and Hemachandra's Grammars of the Prākṛita Dialects), the observation was precise, minute and thoroughly scientific. This was also the case in Materia Medica, and in Therapeutics, especially the symptomology of diseases. In Meteorology, the Hindus used the rain-guage in their weather forecasts for the year, made careful observations of the different kinds of clouds and other atmospheric phenomena (*e. g.*, they give the heights of the clouds, the distance from which lightning is ordinarily visible, or the thunder is heard, the area of disturbance of different earth-quakes, the height to which the terrestrial atmosphere extends, etc., *vide* Varāhamihira, Śrīpati, and the authorities quoted by Ūtpala). In Astronomy, the observation was, generally speaking, very defective as in the determination of the solar and the planetary elements, and this was probably due to the lack of practical interest, but the determination of the lunar constants entering into the calculation of lunar periods.

and eclipses, matters in which the Hindus had a practical ceremonial interest, reached a remarkable degree of approximation (much above Græco-Arab computations) to the figures in Laplace's Tables, which can only be explained by the circumstance that in the case of these constants the Hindus carried out for more than a thousand years a systematic process of verification and correction by comparison of the computed with the observed results (like the navigator's correction of the course of the ship at sea), a process which was termed *दृग्गणितैक्य*. In Zoology, the enumeration of the species of Vermes, Insecta, Reptilia, Batrachia, Aves, etc., makes a fair beginning, but the classification proceeds on external characters and habits of life, and not on an anatomical basis. In Botany, the observation was mainly in the interests of Materia Medica, and the classification was as superficial as possible. (*Vide* my paper on the Hindu Classification of Plants and Animals).

Experiments :—Experiments were of course conducted for purposes of chemical operations in relation to the arts and manufactures, *e. g.*, Metallurgy, Pharmacy, Dyeing, Perfumery and Cosmetics, Horticulture, the making and polishing of glass (lenses and mirrors of various kinds are mentioned, the spherical and oval *डग* and *बतुड*, being well-known—Pliny indeed mentions that the best glass ever made was Indian glass). And the

results of such experiments were freely drawn upon for building up scientific hypotheses and generalisations. But of experiment as an *independent* method of proof or discovery, the instances recorded in books are rare. I may note one interesting example in Udayana's Kiranávati, relating to the weight of air. Udayana argues that air must be a distinct and independent Bhuta, for if air were a form of the Earth-Bhuta, it would have weight, and it has none. To prove the absence of weight, he refers to an experiment. A small bladder made of a thin membrane, filled with air, will not cause a greater descent in the scale than the same bladder weighed empty. Hence the air possesses no weight. Then Udayana makes an interesting statement. It may be objected, he says, by one who accepts the weight of air—that this argument is inconclusive. For a counter-experiment may be suggested. The balloon filled with smoke (or gas, धूम) rises in the air, whereas the air-filled balloon comes down. This would go to show that air has weight. Udayana replies that this would only show that both smoke (or gas, धूम) and air have no weight. The Hindus appear to have been ignorant of the principle of Archimedes. Vallabhácharya in the Lílávati, it is true, speaks of a peculiar resistance to sinking (or gravity) exercised by water, which explains the tendency in certain objects to float.

or to come up to the surface of the water, but the description shows that he had no clear ideas on the subject.]

Mathuránátha, again, states that the determination of the degree of purity ( the carat ) of gold by rubbing against the assaying stone and observing the character of the yellowish streak against the black smooth background, is only an indirect means of ascertaining weight (गुरुत्ववैलक्षण्य lit. specific gravity) —which seems to suggest that there was a more direct means of arriving at the latter. Probably this refers to the common Indian method of comparing the lengths of wires of uniform thickness that can be formed by drawing different pieces of gold of equal weight through the same diamond bore. I think it may be regarded as fairly certain that the Hindus were ignorant of Archimedes's discovery, an ignorance which, at any rate, they could not have well borrowed from the Greeks, no more than they could have thus borrowed their knowledge of things unknown to the Greeks themselves. [ Cf. Udayana, Kiranáli :—

वायुनिरूपणम्, किं च ( वायोः ) पृथिवीत्वे गुरुत्वमपि स्यात् । न च पत्रापूर्वितस्य चर्चपुटकादेः अपूरणदशातः अधिकं अवनमनम् । उन्नोद्यमानस्य धूमापूर्वितेन हृदम् अनेकान्तिकं इति चेत् । न । अत्र धूमदशायां । तत्रापि गरिमविशेषहेतोरवनतिविशेषस्य अप्रतीतिः ।—cf. Vallabhá-cháryya, Lílávati—गुरुत्वविशेषेऽपि पाषाणाणां प्रवृत्तिषु मज्जनी-  
न्यज्जन नियमवत् अदृष्टहेतुत्वात् साम्येऽपि पतनीतृपतन-नियमो भविष्यतीति ।

केचित् न । जलाधीनजनं जलीन धारणं पतनप्रतिबन्ध उन्मज्जनं एतच्च  
जलस्य योगस्य कस्यापिदेव पतनप्रतिबन्धस्यानर्थात् । दृष्टहेतुकमेव मज्जनञ्च  
उन्मज्जनञ्च]—cf. Mathuránátha, सन्निकर्षवादरहस्य on Gan-  
gesa's Tattvachintámani—तस्य ( निक्षीपणस्य ) न सुवर्ण-  
पीताभिव्यक्तकलं किन्तु पीतद्वारा गुह्यत्वेन लक्षणव्यञ्जकत्वमेव तस्य ।

Fallacies of Observation—Mal-observation and Non-observation :—These were carefully studied in relation to errors of observation, and Hallucination (ब्रम, अज्ञान, चारीव),—which were ascribed to three causes :—(a) Dosha, दोष, defect of sense organ, as of the eye in jaundice, or of the skin in certain forms of leprosy ( leading to tactile insensibility, cf. Susruta ), or defect of necessary stimulus, *e.g.*, too faint light, or undue distance or nearness, in vision ; (b) Samprayoga, सम्प्रयोग, presentation of a part or an aspect instead of the whole ; and (c) Sanskára, संस्कार, the disturbing influence of mental predisposition, *e.g.* expectation, memory, habit, prejudice, etc.

The Doctrine of Inference :—Anumāna ( Infer-  
ence) is the process of ascertaining, not by percep-  
tion or direct observation, but through the instru-  
mentality or medium of a mark, that a thing pos-  
sesses a certain character. Inference is therefore  
based on the establishment of an invariable con-  
comitance (Vyápti, व्याप्ति) between the mark,  
and the character inferred. The Hindu Inference  
(Anumāna) is therefore neither merely formal nor  
merely material, but a combined Formal-Material

**Deductive-Inductive Process.** It is neither the Aristotelian Syllogism (Formal-Deductive Process), nor Mill's Induction (Material-Inductive Process), but the real inference which must combine formal validity with material truth, inductive generalisation with deductive particularisation.

An inference admits of a rigorous formal statement,—in the shape of five propositions, for dialectical purposes ( *i.e.* in demonstrating to others ),—or of three propositions when the inference is for oneself ( *स्वाधीनुमान* ) :—(1) the probandum, the statement of the proposition to be established ( *प्रतिज्ञा, साध्यनिर्देश* , *e.g.*, yonder mountain is fiery (say, an active volcano) ; (2) the reason, the ascription of the mark ( *हेतु, लिङ्गव्यपदेश* ),—*e.g.*, for it smokes ; (3) now, the general proposition, stating the invariable concomitance which is the ground of the inference,—clenched by an example bringing home the responsibility of the reasoner to establish a real relation, *e.g.*, whatever smokes is fiery, as an oven ; ( *उदाहरण* ) ;—(4) next, the application, the ascertainment of the existence of the mark in the present case ( *उपनय* ) *e.g.*, yonder mountain smokes ;—(5) finally, the conclusion, the probandum proved ( *निगमन* ), *e.g.*, yonder mountain is fiery.

1. Yonder mountain is fiery.
2. For it smokes.
3. Whatever smokes is fiery, as an oven.

4. Yonder mountain does smoke.
5. Therefore, yonder mountain is fiery.

For inference for oneself, only the first three or the last three propositions, are held to be sufficient.

The Hindu Anumāna, it will be seen, anticipates J. S. Mill's analysis of the syllogism as a material inference, but is more comprehensive;—for the Hindu Udāharana, the third or general proposition with an example, combines and harmonises Mill's view of the major premise as a brief memorandum of like instances already observed, fortified by a recommendation to extend its application to unobserved cases, with the Aristotelian view of it as a universal proposition which is the formal ground of the inference. This Formal-Material Deductive-Inductive process thus turns on one thing—the establishment of the invariable concomitance (व्यप्ति) between the mark and the character inferred,—in other words, an inductive generalisation. The question is—what is our warrant for taking the leap from the observed to unobserved cases? Under what conditions are we justified to assert a Universal Real Proposition on the basis of our necessarily limited observation?

The Chārvāka view :—Among the Chārvākas there were two classes, the cruder school of materialists who accepted perception (प्रत्यक्ष) as a valid source of knowledge, as well as the reality of

Natural Law (स्वभाव), and the finer school of sceptics, who impugned all kinds of knowledge, immediate as well as mediate, and all evidence, Perception as well as Inference, *vide* Jayanta's reference in the Nyāya-Manjarī to सुविचिंतयार्थीकाः; also चार्वाकधूर्तस्तु ज्ञातव्यं व्याख्यास्यम इति प्रतिज्ञाय प्रमाणवैयर्थ्यात्तद्व्यवस्थितमाशङ्क्यकरणोपलब्धेव व्याख्यातवान्—A'hnika I, Manjarī.

The Chārvākas hold that the principle of causality, which the Buddhists assume to be a ground of an induction (व्याप्ति) is itself an induction (a case of Vyāpti), which amounts to reasoning in a circle (चक्रे); that every inference is based on an unconditional invariable concomitance which itself must be inferred, as universal propositions cannot be established by our limited perceptions, and thus there is a regressus ad infinitum (अनादि परम्परा); and that the nexus between cause and effect, or between the sign and the thing signified (*e.g.*, smoke and fire) is only a mental step or subjective association based on former perception, a mental step which by accident is found justified by the result in a number of cases.

The Buddhists—their Analysis and Vindication of Inference :—The Buddhists, however, take their stand on the principle of the Uniformity of Nature (प्रतिबन्ध, स्वभाव प्रतिबन्ध, Nyaya-Vindu). This uniformity, for scientific purposes, has to be divided into two different relations,—(1) the uniformity of succession in the relation of cause and effect, *e.g.*,

of smoke to fire (कार्यकारणभाव, तदुपपत्ति, Nyaya-Vindu) ; (2) the uniformity of co-existence ( in the form of co-inherence in the same substrate) in the relation of genus and species, *c.g.*, the relation of invariable concomitance expressed in the proposition,—all Sinsapás are trees,—which is not a relation of causality, but of co-existence or co-inherence in the same substrate (*i.e.*, the co-inherence of the generic qualities of a tree with the specific characters of a Sisu tree, in this particular individual before me, a Sisu tree ),—a relation which may be termed essential identity ( तादात्म्य, स्वभाव—Nyaya-Vindu ). To these two, the Buddhists add a third ground of inference, non-perception of the perceptible ( अनुपपत्ति, दृश्यानुपपत्ति ), which is employed in inferring the absence ( प्रतिषेध ) of a thing from the non-perception of something else. In all cases of inference based on the Uniformity of Nature, the relation is that of inseparableness or non-disjunction between the mark and the character inferred. The question is—how is this inseparableness ( अविवर्तिभाव ) ascertained, and what is the warrant of our belief in it, in these cases ?

Ascertainment of Inseparableness or Non-disjunction : Buddhist Account :—First take the case of causation. The cause is the invariable antecedent of the effect. What is meant is that the specific effect (with all the distinctive and relevant accompaniments, कार्यविशेष) is invariably preceded by a

specific cause (कारणविशेष). It is not that clouds always lead to rain, or that floods in the river valley always imply rain in the hills higher up. But this particular conjunction of antecedent circumstances (*e.g.* the appearance of a particular kind of clouds accompanied with flashes of lightning, the roll of thunder and flights of Valákás,—driven by the wind from a particular quarter of the horizon, and ascending in black masses, etc.) is as a rule the precursor of a particular assemblage of rain effects (rain with particular accompaniments). Again, this particular kind of flood (overflowing of the river banks accompanied with muddy discoloration of the water, rapid currents, the bearing down of tree trunks, etc.) is always preceded by rain in the hills higher up (though, no doubt, other cases of floods in a river may be due to a breach in an embankment or the melting of the snows). In other words, the Buddhists (and the earlier Nyáya Schools) avoid the difficulty arising from the plurality of causes by taking into consideration the accompanying phenomena, which, if properly marked, would always point to a specific cause of a specific effect.

I quote Nyáya authorities, but this device to obviate the plurality of causes is common to the early Nyáya and the Buddhistic systems.

पूर्ववत् । यत्र कारणेन कार्यमनुमीयते । उदाहरणम्—

मेघोन्नत्या भविष्यति उदिरिति कारणेन कार्यानुमानम् । अथ

पुनरस्य प्रदीपः । इष्टिमन्तः एते मेषाः गन्धोदध्निबन्धे सति बहुबलाका-  
बन्धे सति अक्षिरप्रभावबन्धे सति सन्नतिमत्त्वात् इष्टिमन्तश्च वत् ।

शेषवत् ( यत्र कार्येण कारणमनुमीयते )—उदाहरम्—

उपरिइष्टिमहंशसम्बन्धिनो नदीकोतः शीघ्रत्वे सति पूर्वफलकाष्ठादि-  
बहुनबन्धे सति पूर्वत्वात् पूर्वंइष्टिमन्तहीवदिति । ( Udyotakara,  
Chap I. Āhnikar, Sūtra 5). Vāchaspati puts this  
clearly:—यद्यपि कारणमात्रं व्यभिचरति कार्योत्पादं तथापि सादृशं  
न व्यभिचरति तत्र निपुत्रेण प्रतिपत्ता भवितव्यम् । अथवा धूमनामपि वज्रि-  
मत्ता व्यभिचरतीति न धूमविशेषो गमको भवेत् । In other words,  
a single condition called a cause is not invariably  
succeeded by the effect, nor does the effect  
phenomenon in general point to any particular  
cause as antecedent, for there may be a plurality of  
causes of a general effect. The skilful observer  
will therefore select the full complement of  
causal conditions, which is invariably succeeded by  
the effect,—and also the specific effect (*e.g.*, धूमविशेष)  
which points to a specific causal antecedent.  
Compare also Jayanta :—we infer an effect from a  
specific assemblage of causes—न च कारणमात्रस्य हेतुत्वं तुमी  
शेनास्य व्यभिचारः स्यात् । अपि च विशिष्टमेव कारणं हेतुः । न च  
कारणविशेषो दुरवगमः । गन्धोदगन्धितारण्यनिर्भिन्नगिरिगह्वराः रोलन्त्य-  
गवत्तयावतमानसमखिलस्त्रियः ...इष्टिं व्यभिचरन्तीह नैव प्रायः पथीमुचः ।  
चनभ्युपगमे चैवमनुमानस्य जीवितम् । न स्याद्भूमविशेषाच्चाप्यपि वीर्यम-  
नङ्गितः । Similarly we infer a specific cause from  
a specific assemblage of effects :—शेषवदिति यत्र कार्येण

कारणमनुमीयते यथा नदीपूरेण उपरितने दृष्टे उदिरिति । उदिरत-  
पृष्ठदेशसंघटा ईधं नदी फेनिलककुषत्वादिविशिष्टपूरीयेतत्वात् । यत्तु  
सेतुमङ्गलमविलम्बनादिनापि नदीपूरीयसति दृष्टा इति तत्रापि लक्ष्यते—

प्रमातुं रपरायीऽयं विशिषं यी न पश्यति ।

नानुमानस्य दोषीऽस्ति प्रमेयाव्यभिचारिणः ॥

(Nyāya-Manjarī, A'hnikā 2, on Gotama Sūtra  
5, A'hnikā 1, Chap I.)

A specific assemblage of causes, therefore, has only one specific assemblage of effects, and *vice versa*. Of course, the observer is to find out the essential or relevant features (as distinguished from the irrelevant ones) which, being included, will enable him to specify the particular cause of the particular effect.

Now this being premised to be the exact meaning of the inseparableness or non-disjunction in the case of cause and effect, we come to the question with which we started—how is this relation to be ascertained or established between two phenomena or assemblages of phenomena? Obviously, mere observation of their agreement in presence ( *समवेद* ) and their agreement in absence ( *व्यतिरेक* ) is no help in the matter. Take a concrete example. The ass is customarily employed to bring the fuel with which fire is lighted. In a hundred cases you have observed the ass among the antecedents of smoke. In a hundred cases you may have observed that when there is no ass, there is no smoke. This is no

warrant for concluding a relation of cause and effect between an ass and smoke. It may be that you happen to have never observed smoke without an antecedent ass, or an ass without smoke following. Even this is of no avail. It is not agreement (unbroken and uniform though it be) in presence, or in absence, or in both, that can settle the matter. There is one and only one way of ascertaining the causal relation. Suppose *A* with certain accompaniments is found to precede *B* immediately. Now if *A* disappearing, *B* disappears, even though all other antecedents remain and there is no other change in the case, then and then only can the causal relation be ascertained. It is not a mere table of positive instances or negative instances (अदर्शनात् न दर्शनात्);—it is this method which we may term the Method of Subtraction (the Method of Difference in its negative aspect) that is the only exact and rigorous scientific Method. Such was the statement of the earlier Buddhists (cf. Udyotakara's and Vāchaspati's report of the Buddhist Doctrine of Inference—स हि प्रतिबन्धी न दर्शनमात्रावसेयः ।

तस्यात् तादात्म्यतदुत्पत्तिनिबन्धनः एव प्रतिबन्धः । यदाह कार्यकारणभावाद्वा स्वभावाद्वा नियामकात् । अविनाभावनिवर्तोऽदर्शनात् न दर्शनात्—a Buddhist Karika quoted in Vāchaspati, Udayana, Śrīharsha, Mādhava, etc.)—कार्यकारणभावश्च इदम्—अस्मिन् सति भवति—सत्सु अपि तदस्यैव अस्मिन्नसति न भवति—एवमाकारः । न अन्यव्यतिरेकाभावात्तिरिच्यते ।... ( एवं तादात्म्यमपि विपर्यये वाचक-

प्रमाणीपपत्ता निश्चेतव्यम् ।...तस्मात् तादात्म्यतदुत्पत्तिभ्यामेव प्रतिबन्धो  
नान्यतः ।—Vāchaspati, Tātparyyatikā, Chap I, A'hnika  
I, Sutra 5, अनुमानसूत्रम्—व्याप्तिबन्धोपायः )

But the canon in this form is not sufficiently safe-guarded against possible abuse. Two points have to be emphasised :—(1) It must be carefully observed that no other condition is changed, (2) that the appearance and disappearance of *A* must immediately precede the appearance and disappearance of *B*. The definition of a cause is based on two fundamental characters, (1) the unconditional invariableness of the antecedence, and (2) the immediateness of the antecedence. The canon of the Method of Difference must therefore be stated in such a form as to emphasise each of these aspects. And one main difficulty in the practical application of the canon is that along with the introduction or sublation of an antecedent, some other phenomenon may be introduced or subluted unobserved. As a safe-guard against this radical vitiation of the Method, the later Buddhists formulated the canon of a modified Method, termed the Panchakārani, a Joint Method of Difference, which combines the positive and the negative Methods of Difference ( the Method of Addition and the Method of Subtraction ) in a series of five steps, and which equally emphasises the unconditionality and the immediateness of the antecedence as essential moments of the causal relation. This is

neither agreement in presence, nor agreement in presence as well as absence (the foundation of J. S. Mill's Joint Method of Agreement), but the Joint Method of Difference. The Panchakārani runs thus :—

The following changes being observed, everything else remaining constant, the relation of cause and effect is rigorously established :—

First step—The 'cause' and the 'effect' phenomena are both unperceived.

Second step—Then the 'cause' phenomenon is perceived.

Third step—Then in immediate succession, the 'effect' phenomenon is perceived.

Fourth step—Then the 'cause' phenomenon is sublated or disappears.

Fifth step—Then in immediate succession, the 'effect' phenomenon disappears.

Throughout, of course, it is assumed that the other circumstances remain the same (at least the relevant or material circumstances).

This Panchakārani, the Joint Method of Difference, has some advantages over J. S. Mill's Method of Difference, or what is identical therewith, the earlier Buddhist Method; and the form of the canon bringing out in prominent relief the unconditionality and the immediateness of the antecedence, is as superior from a theoretical point of view to J. S. Mill's canon,

and is as much more consonant than the latter to the practice of every experimenter, as the Hindu analysis of Anumāna as a Formal-Material Deductive-Inductive Inference is more comprehensive and more scientific than Aristotle's or Mill's analysis of the Syllogism (or Mediate Inference).

But even the Panchakārani is no sufficient answer to the question with which we started. The Panchakārani is only a method ; it shows only how in a particular case the relation of cause and effect is to be established (प्रतिबन्धवहोपाय). But we want more than this—we require a warrant for the process. The Buddhists therefore supply the following proof of the Method :—Doubt is legitimate, but there is a limit to doubt. When doubt lands you in a contradiction of a fundamental ground of practice, and would thus annul all practical exercise of the will, the doubt must cease ; else the doubt would be suicidal or sophistical. In this particular case, when the Panchakārani is satisfied, the antecedent in question must be the cause, for there is no other antecedent to serve as cause ; the proof is indirect but rigid. If this be not the cause, there is no cause of the phenomenon. It was not, and it begins to be, without a cause ; which would be a contradiction of the rational ground of all practice, for all volitional activity proceeds by implication on the principle of causality. If things could happen

without a cause, all our motives to action would be baffled. The link between a presentation and the instinctive volitional reaction would snap, and the circuit of consciousness would be left incomplete. In fact, the Buddhists go further ; they hold causal efficiency ( *वर्धकिया* ) to be of the essence of empirical ( relative ) Reality. The proof of the Joint Method of Difference, then, lies in a strict application of the principle of causality in its negative form (*viz.*, there can be no phenomenon without a cause) and the truth of this last is guaranteed by the same ultimate criterion of empirical ( relative ) Reality as the truth of Perception itself, *viz.*, the correspondence between the rational and the practical activity of the self.

But invariable concomitance (or non-disjunction), the Buddhists argue, has another form, *e.g.*, the relation of the genus to the species. We may have perceived a hundred instances of the association of certain characters with certain others ; we may also have never perceived the former when the latter are absent ; but this would not enable us to generalise and establish invariable and unconditional co-existence. We must be first satisfied that there is identity of essence ( *तादात्म्य स्मरण* ). It is only when we perceive that the characters of a *Sinsapá* are co-inherent with the generic characters of a tree in the same individual object ( a *Sinsapá* tree before me ), and when we further

perceive that the characters are held together by the relation of identity of essence, that we can say that all Sinsapás are trees. For as there is identity of essence, a Sinsapá would not be a Sinsapá, if it were not a tree. It would lose its self-identity which is a contradiction. Hence the relation of identity of essence (तादात्म्य स्वभाव), as in the relation of the species to the genus, is the sole ground for establishing uniformity of co-existence (प्रतिवन्ध, स्वभावप्रतिवन्ध).

(For the Buddhist Method of Induction, in its later form, the Panchakárani, vide Sarvadarsana Sangraha—Buddhist reply to the Chárváka attack on Inference :—

यदभ्यधासि अविनाभावो दुर्बोध इति तदसाधीयः । तादात्म्यतदुत्पत्तिभ्यामविनाभावस्य सुज्ञानत्वात् । तदुक्तं—कार्यकारणभावात् वा स्वभावात् वा नियामकात् । अविनाभावनियमोऽदर्शनाद्य न दर्शनात् । As for the Nyáya view अन्वयव्यतिरेकी अविनाभावनिश्चयको इति.—the Buddhist objects—ननु पक्षे साध्यसाधनयोरव्यभिचारी दुरवधारणः भवेत् । भूतं, भविष्यति, वर्तमाने अनुपलभ्यमाने च व्यभिचार-शङ्काया अनिवारणात्.—the Nyáya retorts ननु तथाविधस्यैव तावकेऽपि मते व्यभिचारशङ्का दुष्परिहारा इति.—the Buddhist answers—मेवं वीचः, विनापि कारणं कार्यमुत्पद्यताम् इत्येवं विधायाः शङ्कायाः व्याघातावधिकृतया निवृत्तत्वात् । तदेव हि आशङ्क्येति यच्चिन्नाशङ्क्यमाने व्याघातादयः नावतरियुः । तदुक्तं व्याघातावधिराशङ्का इति । तथात् तदुत्पत्तिनिश्चयेन अविनाभावी निश्चीयते । तदुत्पत्तिनिश्चयस्य कार्यहेतुः प्रत्यक्षोपलब्धानुपलब्धपक्षनिवन्धनः ।

कार्यस्य उत्पत्तेः प्रागनुपलब्धः, कारणोपलब्धे सति उपलब्धः, उपलब्धस्य पश्चात् कारणानुपलब्धात् अनुपलब्धः इति पञ्चकारिका धूम-धूमध्वजयोः कार्यकारणभावः निश्चीयते । तथा तादात्म्यनिश्चयेन अपि अविनाभावः निश्चीयते । यदि शिंशपाः हस्तम् अतिपतित् स्वात्मानमेव ज्ञात्वा इति विपक्षे बाधकप्रवृत्तेः । अप्रवृत्ते तु बाधकी भूयः सरभावोपलब्धोऽप्यभिचारग्रहायाः को निवारयिता । शिंशपाहचयोश्च तादात्म्यनिश्चयः ह्योऽयं शिंशपा इति सामानाधिकरण्यावलात् उपपद्यते । तथात् कार्यात्मानौ कारणम् आत्मानम् अनुमापयत इति सिद्धम् । Sarvadarsana-Sangraha, Bauddha-Darsanam.

**The Nyāya Doctrine of Inference :—**The Nyāya easily demolishes the Buddhist contention about identity of essence. The Nyāya writers, being realists, do not impugn the reality of the genus ( जाति ) like the nominalists or the nominalistic conceptualists in the Mimamsa Schools ( भाट्टः and पासाकराः ) ; but they point out that the inseparableness ( or non-disjunction ) in such cases can only be established by the experience of unbroken uniformity ( अव्यभिचारित्व *i.e.*, by अवयवव्यतिरेकी, दर्शनादर्शने ). Uniform agreement in presence with uniform agreement in absence, —not the mysterious identity of essence irresistibly perceived in any individual case or cases—is the only basis for constituting genera and species in Natural Classification. Indeed some of the later Nyāya writers point out that individuals do not always possess in Nature all the characters that go to form the definition of the class to which they are referred.

Similarly, as regards the relation of cause and effect, a *nexus* is sometimes fancied to be perceived, a power in the cause to produce the effect ( शक्ति ), or an ultimate form ( जाति सौख्य ), which is supposed to be present, whenever the effect (quality or substance) is produced (cf. Bacon's view of the 'Forms' of Simple Qualities). All this is neither a matter of observation nor of legitimate hypothesis. There is nothing except the invariable time-relation (antecedence and sequence) between the cause and the effect. But the mere invariableness of an antecedent does not suffice to constitute it the cause of what succeeds ; it must be an unconditional antecedent as well ( अव्यवहितिद्विगुणस्य निवृत्तपूर्व-वर्तिता, being the definition of कार्यकारणभाव ). For example, the essential or adventitious accompaniments of an invariable antecedent, may also be invariable antecedents, but they are not unconditional but only collateral and indirect, in other words their antecedence is conditional on something else ( न स्वातन्त्र्ये ). The potter's stick is an unconditional invariable antecedent of the jar, but the colour of a stick, or its texture or size or any other accompaniment or accident, which does not contribute to the work done (so far as we are considering it) is not an unconditional antecedent, and must not therefore be regarded as a cause. Similarly, the co-effects of the invariable antecedents, or what enters into the production of these

co-effects, may themselves be invariable antecedents but they are not unconditional, being themselves conditioned by those of the antecedents of which they are effects. For example, the sound produced by the stick, or by the potter's wheel, invariably precedes the jar, but it is a co-effect,—and A'kása ( ether ) as the substrate, and Vayu (air) as the vehicle, of the sound, enter into the production of this co-effect, but these are not 'unconditional' antecedents, and must therefore be rejected in an enumeration of conditions or causes of the jar. Again, the conditions of the conditions, the invariable antecedents of the invariable antecedents, are not unconditional. The potter's father is an invariable antecedent of the potter who is an invariable antecedent of the jar, but the potter's father does not stand in a causal relation to the potter's handiwork. In fact, the antecedence must not only be unconditionally invariable, but must also be immediate (अव्यवहितपूर्वकादावच्छेदेन कार्यदेवे सत्त्वम्). Finally, all seemingly invariable antecedents which may be dispensed with or left out, are *ipso facto* not unconditional, and cannot therefore be regarded as causal conditions ; in short, nothing that is unnecessary is unconditional ; for this class, *vide* Visvanátha:—निवृत्तावश्यकपूर्वभाविनः अवश्यकसुनियतपूर्ववर्तिन एव कार्यसम्भवे । तद्वत्त्वं ( अतिरिक्तं ) अव्यवहितम्—Visvanátha, Siddhánta Muktváli, on Sloka 20. For example, it is the custom to point to spátial position or direction with the

fingers, but finger-pointing, though invariably present, is not causally related to the perception of direction or spatial position, because we can imagine such perception without finger-pointing, ( *अन्यथासिद्धतया बहुधा निर्देश्य दिक्प्रत्यक्षत्वेन न स्वाभाविकः स्वत्वः*, Váchaspati, Tát-paryya-Tiká, Chap. I, A'hnika 1, Sutra 5,—this shows that the doctrine of *अन्यथासिद्धित्वम्* was long anterior to Gangesa).

[Visvanátha in the Bhásha-Parichchheda mentions five kinds of *अन्यथासिद्ध*, conditional antecedents—(1) येन सहपूर्वभावः, (2) यस्य वा कारण-मादाय (पूर्वभावः), (3) अन्तर्प्रति पूर्वभावे ज्ञाते यत्पूर्वभावविज्ञानम्, (4) जनकं प्रति पूर्ववर्तिताम् अपरिज्ञाय यस्य (पूर्ववर्तिता) न गृह्यते, and (5) अद्यापि यत् नियतावश्यकपूर्वभाविनः अतिरिक्तम् भवेत् (एतेषु पञ्चसु आवश्यकस्त्वही—Slokas 19, and 20), यस्य स्वातन्त्र्ये च अन्यव्यतिरेकी न सः किन्तु स्वकारणमादायैव अन्यव्यतिरेकी गृह्यते तदन्यथासिद्धम्, Siddhánta Muktváli, loc. cit.—The Dinakari points out that the first two cases are comprehended under the formula इतरान्वयव्यतिरेक प्रयुक्तान्वयव्यतिरेकशालित्वम् । There are several classifications of these irrelevant antecedents (*अन्यथासिद्ध*) ; I quote one of the best known].

The unconditional (*अन्यथासिद्धित्वम्*) as interpreted in this comprehensive sense is a far more fruitful conception than Mill's, and is well adapted to its work—the elimination of the irrelevant factors in the situation. In the end, the discrimination of what is necessary to complete the sum of causes, from what is de-

pendent, collateral, secondary, superfluous or inert, (*i.e.* of the relevant from the irrelevant factors) must depend on the test of expenditure of energy. This test the Nyáya would accept only in the sense of an operation analysable into molar or molecular motion (परिचय्य एव भौतिकी व्यापारः करोत्यर्थः—चतुर्द्विषय व्यापारी शक्ति, Jayanta, Manjarí, A'hnika I); but would emphatically reject, if it is advanced in support of the notion of a mysterious causal power or efficiency (शक्ति). This is a peculiarity of the Nyáya—its insisting that the effect is only the sum or resultant of the operations of the different causal conditions—that these operations are kinetic, being of the nature of motion, in other words holding firmly to the view that causation is a case of expenditure of energy, in the kinetic form,—but at the same time absolutely repudiating the Sāṅkhya conception of power or productive efficiency as metaphysical or transcendental (चतुर्द्विषय), and finding nothing in the cause other than an unconditional invariable complement of operative conditions (कारणसामग्री) and nothing in the effect other than the consequent phenomenon which results from the joint operations of the antecedent conditions (समुदितसकलकारकान्तर परिचय्य एव—Jayanta—सामग्री कार्य—सामग्रीकार्यत्वे तु कार्य-मत्तु किमन्तराद्यवसिन्वा वक्तव्या—Jayanta, *ibid*, A'hnika, I, शक्तिनिराकरणम्—it may be noted that the Nyáya, while repudiating transcendental power (Sakti) in the mechanism of nature and natural causation,

does not deny the existence of metaphysical conditions like merit (पुण्यं) which constitute a system of moral ends that fulfil themselves in and through the mechanical system and order of Nature—*vide* Jayanta, 'अतोन्द्रियं किमपि कारणं कल्पितमेव पुण्यं हि—A'hnika I, अक्षिनिराकरणम् ).

The causal relation, then, like the relation of genus to species, is a natural relation of concomitance (व्याप्तिः स्वाभाविकः सख्यत्वः—Vāchaspati) which can be ascertained only by the uniform and uninterrupted experience of agreement in presence and agreement in absence, and not by deduction from a certain *a priori* principle like that of Causality or Identity of Essence.

Nyāya objection to the Buddhist Method of Difference as a means of ascertaining causality.

Take for example the Buddhist deduction of Causality in any particular conjunction by means of the negative Method of Difference, or of the Panchakārani. The ascertainment of the causal relation by these Methods is open to the following objections :—(1) The unconditionality of the antecedent cannot possibly be ascertained. As the Chārvāka rightly points out, the Methods enable you to eliminate irrelevant antecedents that are or can be perceived ; but the introduction or sublation of latent or undetected antecedents can be imagined against which the Method of Difference is powerless. In the case of the production of smoke, for

example, by fire,—what if I say that an invisible demon intervenes in every case between the fire and the smoke, that this demon ( विज्ञात ) is the immediate antecedent and real cause of the latter, and that the fire is an accident which, in every such case, is brought about by its own causal antecedents ; —in saying this, I do not go counter to the principle of causality and am landed in no contradiction ( व्याघात ) such as strikes at the very roots of all practice, or baffles the completed circuit of consciousness, however much I may violate probability.

(2) In the second place, even supposing that the fire, in this particular case ( which satisfies the Method of Difference rigidly ) is ascertained to be the cause of the smoke, how can I know that fire is the cause in other cases, or that there is no other cause. You will perhaps argue that if there were an *indefinite* number of causes of the same specific phenomenal effect, it would violate the principle that phenomena are all conditioned, *i.e.*, exist only under certain conditions ( कारावशिष्टकल ),—which is more comprehensive than the principle of causality, and the contradiction of which equally overthrows all rational practical activity. Yes, I accept the conditionality of phenomena, but this is not violated by supposing that one specific assemblage of phenomena has more than one cause. It is true that if you suppose such plurality of causes, you cannot establish the invariableness of

the particular conjunction (green-wood fire and smoke) which your Method of Difference fixes upon as a case of cause and effect; in other words, with your special principle of Causality so restricted, and without any general principle of Uniformity of Nature to fall back upon, you cannot ascertain, from the present case, or from any number of similar cases that you may have observed, that *all* green-wood fires are followed by smoke; *i.e.*, you are helpless in demonstrating with apodictic certainty (or ascertaining indubitably) the relation of cause and effect. But this is an objection against your own position, not mine. Why not admit at once that certain phenomena are naturally connected (as invariable concomitants or antecedents) with other phenomena, and take your stand on observed concomitance (uniform and uninterrupted experience of agreement in presence as well as absence) without assuming causality as an *a priori* principle and making deductions therefrom, and without the trouble of ascertaining the relation of cause and effect in every individual case. I am free to admit that theoretical objections of irresistible force (like those of the Chārvāka Sceptics) can be urged against this ascertainment of universal invariable and unconditional concomitance (व्याप्तिवद्दीपाद्य) on the basis of mere observation. Doubts of this kind can no more be laid by my view of the matter than by your canons of causality and essential

identity (तदुत्पत्ति and तादात्म्य). Ultimately we all have to fall back on the rational practice of thinking persons (चेत्तान्तः), and such persons are always content to act on practical certitude instead of hankering after an unattainable apodictic certainty in the affairs of life (प्रामाणिकलीकयादानु-पासयता यथादर्शनं ब्रह्मनीयम्). This same practical certitude is also the ultimate warrant of the Deductive-Inductive Inference by which we ascertain the characters of things without direct perception and through the medium or instrumentality of a mark.

[To the earlier Buddhist canon of the Method of Subtraction, *i. e.*, the negative Method of Difference, Udyotakara and Vāchaspati of the Nyāya School pertinently and acutely object as follows :—

सत्यं यत् किञ्चित् कश्चित् दृष्टं तस्य यत्र प्रतिबन्धः, तद्विदुः तस्य तत्  
गमनं तत्र इति अनुजानीमः । स एव तु प्रतिबन्धो न तावत् तदुत्पत्त्या ।  
सम्भवति । का पुनरियं तदुत्पत्तिः । धूमस्य किं वज्रगमनस्य भावः । स  
तादृशः अस्ति रासभस्यापि । तत्र प्रतिबन्धोऽपि धूमः स्यात् । अथ तदनन्त-  
रनेव भावः, न च रासभानन्तरं भवन्नपि तदनन्तरनेव भवति, तस्मिन् सति  
अपि असति अग्नौ तदभावात् । असति अपि तस्मिन् सत्याद्र्शेन भवति  
वज्रो तदभावात् । अथ यद्यपि धूमस्य वज्रभावावुपिधानं ततोपलब्धं,  
तथापि दीप्तान्तरादिषु तदभावीऽन्व कुतस्तथा । तथा हि भूयो भूयो  
रासमे दृष्टे धूमीदृष्टः, तदभावे च अदृष्टः, न स तत्कार्यः । तज्जातीय-  
स्यैव धूमस्य रासमं विना सति वज्रो भावात्, एवं सद्यपि अग्नौ पिशाचिन  
जनिती धूमः, कश्चिद्देवादेौ तज्जातीय एव रासभवद्वज्रभावेऽपि पिशाचा-  
देव भविष्यति, इति अवश्यं ब्रह्मा भाव्यं नियामकं अपश्यताम् । न च सति

भावमात्रं नियामकं, तस्य रासभादिषु अविवक्षितम् । तदनकारमेव इति च अवधारणस्य शङ्कायामभावात् । अवधारणेन तु शङ्कापनयने परस्परान्वय-  
प्रसङ्गात्

Buddhist reply :—आदेतत् । यी यी धूमोदष्टः स सूर्यस्तावत् आद्रेत्यनसृजित वज्रानकारमेव, न पिशाचानकारं । स च कादाचित्कतया निमित्तमपेक्षमात्रो यदनकारमेव गम्यते तदेव अप्रतीतव्यभिचारं निमित्तं करोति, न तु प्रतीतव्यभिचारं रासभादि । नापि सूर्ययाऽनुपपन्नव्यपिश्रा-  
चादिः । यदि न तन्निमित्तं कस्यात् विनाऽपि वज्रं क्वचित् धूमो न उप-  
पद्यते । अथ असौ ( पिशाचः ) सूर्येण वज्रसृजितः तथा सति आद्रेत्यन-  
वत् कथं वज्ररपि न कारणं । कारणं चेत् कथं तमनरीश धूमभाव शङ्का ।  
Now the phenomenon that is contingent ( कादाचित्क ) cannot be uncaused—अकारणस्य हि कार्यस्य नित्यं सत्त्वं असत्त्वं वा स्यात्, अनपेक्षत्वात् न कादाचित्कत्वम् । And with the limitation of a specific effect, there must be only one specific cause, for an unrestricted plurality of causes would amount to the denial of uniformity in causality ( *i. e.*, of the *unconditional invariable* antecedence )—

नापि अनेकं कारणं, अकारणत्वप्रसङ्गादेव । वज्रानकारमेव भाव इति हि धूमस्य वज्रकार्यत्वम् । स चेत् अवज्रेरपि अनकारं, न एवकाराद्यः स्यात्, इति न वज्रेः कार्यम् । एवम् अन्यस्यापि न कार्यं । न हि अन्यानकारमेव भवति, वज्रेरपि अनारं भावात्, ततश्च अहेतुको धूमः स्यात् । तथा च कादाचित्कत्वस्यावृत्तिः ।

Nyāya rejoinder :—सत्यम् । यद्यपि विना वज्रं नोपपत्ती नूनः, यद्यपि च पिशाचानकारं नोपपत्त्यते तेषामनुपपन्नः, तथाऽपि पिशाच-

कार्यं एव धूमः । तत्र तत्र वक्रिः कुतश्चित् स्फुरितोः उपनिपतितः, राखभ इव,  
न धूमस्य जनकः । तेन तदभावेऽपि तज्जातीय एव कारणभेदजम्भा  
कदाचित्, कदाचित्को धूमः स्यात् । इति अनिहतिरेव शङ्कायाः ।  
न च दृष्टसम्भवे नादृष्टं कल्पयितुं युक्तम् इति शक्यं भवद्विर्वक्तुम् । अनुप-  
लब्धिलक्षणप्राप्तस्य अशक्यनिराकरणत्वात् (vide Nyáya Vindu). न च  
अनुपलब्धग्रन्थराशि अपि तन्निषेधे प्रभवति । तस्मात् अनन्तरमेव इति  
अवधारणाभावात् भेवं कार्यकारणभाववधारणं युक्तम् । न च यदन्य-  
सङ्घितानन्तरं उपलब्धं तत्, तदन्यरङ्घितात् तस्मात् भवत् भिन्नजातीयं भवति ।  
उक्तं हि रामभसङ्घितात् वक्रिः यादृशी धूमः तादृश एव तद्वरङ्घितात् वक्रि-  
रिति । तस्मादेवंविधा शङ्कापिशोः स्निवारकं तदुत्पत्तिनिश्चयमास्कन्दती  
न शङ्का निवारयितुम् ।

The Nyáya proceeds to point out that what is contingent need not necessarily be produced by a cause. It is enough if there is natural connection with something else, a relation of antecedence and succession (or concomitance), without any element of productive efficiency or causation.

अपि चास्तु तदुत्पत्तिनिश्चयः तद्याऽपि कस्यात् कारणमन्तरैव न कार्यं  
भवति । तथा च सति अनपेक्षतया कदाचित्कत्वविहितः इति चेत् ।  
अस्तु तर्हि सम्बन्धः स्वाभाविकतया अन्यानपेक्षः अव्यभिचारो गमकत्वाकम् ।  
स च यो वा स वा भवतु । कृतं कार्यकारणभाववधारणायासेन । यथा  
चेत्तत् तथा चचे दृग्दृष्टिमानः । Váchaspati, Tātparyya-Tíkā,  
Chap. I, A'hnikā 1, Sutra 5, व्याप्तिपट्टोपावधिचारः । ]

The Nyáya analysis of the causal relation continued :—Co-effects :—In the enumeration of dif-

ferent varieties of irrelevant antecedents (अव्यवसिद्ध), we have already noticed that co-effects of the same cause are apt to be confounded as cause and effect. In some cases, the co-effects may be simultaneous, *e. g.*, the case of the ascending and the descending scale in a balance, which are co-effects of gravity (*vide* Pārtha-sārathi Misra on Kumārila, Sloka-Vārtika—तन्नामननीयमनयोस्तु न निधः कार्यकारणत्वम्, उभयोरेककारणत्वात्,—sloka 157, Sūnya-Vāda). In other cases, the co-effects may be successive effects of the same cause, and here the risk is great of mistaking the antecedent co-effect to be the cause of the succeeding co-effect ; *e. g.*, the case of ants moving in a line to carry their eggs upward, which is observed before the summer rains ;—where the movement of ants and the rains are not cause and effect, but successive effects of the same cause, *viz.*, the heat (उष्ण), which disturbs the elements, *viz.*, the earth and the atmosphere (महाभूतक्षोभ) ; the ants being affected by this heat earlier than the atmospheric movements which bring the clouds and the rain.

(Udyotakara, and Vāchaspati—न च विपीलिकाण्ड सचरणं वर्षस्य कारणमनुपलब्धवान्प्रातः । असत्यपि तस्मिन् वर्षस्योत्पत्तेः । वर्षमूलकारणस्य तु महाभूतक्षोभस्य विपीलिकाण्डसचरणं पूर्वकार्यम् । कथ्यमानाः खलु विपीलिका भीमेनीषणा खानि चक्षानि भूमिष्ठानि उपरिष्ठात् नयन्ति—Tātparyya—Tikā II, 2, Sutra 37).

Synchronousness of Cause and Effect.—This is resolved into a case of simultaneous co-effects of the same ultimate cause, *e.g.*, the ascent of one scale and the descent of the other in the balance, which are not related as cause and effect, but are simultaneous effects of gravity. In other cases, the synchronousness is only apparent, the interval between the antecedent and the consequent being too small (सूक्ष्मकाल) to be apprehended (योगपद्याभिमान) *e.g.*, in the case of the needle piercing a hundred soft lotus petals laid one upon another, where the steps are really successive; or the illumination of the whole room by the light of a lamp, where the succession is unperceived owing to the inconceivable velocity of light (cf. Kumárilá, Sloka-Vartika,—हेतुहेतुमतां सिद्धं योगपद्य-निदर्शनम्,—यत् प्रदीपप्रभादुक्तं, सूक्ष्मकालोऽस्ति तत्र नः । दुर्लभस्तथा वैद्यः पद्मपत्रवत् तथा । Sunyaváda, Sloka 156-157.—I quote Mimansa authorities, but the view is common to the Mimánsá and the Nyáya-Vaiseshika).

The time-relation in a chain of causes and effects :—A careful study of the time-relation in a chain of causes and effects is a peculiarity of the Vaiseshika system (and the later Nyáya). A moment (ultimate unit of time, Kshana, क्षण) is defined to be the time-interval between the completion of the sum of conditions and the appearance of the effect. The Vaiseshika conceives the unit to be determined by reference to the division

of one atom from another ( विभागावृत्तप्राप्तविभाग  
प्रागभावसम्बन्धकयोर्वच्छिन्नः कालः सप्तः—Sapta Padārthī, Sivā-  
ditya ;—*i.e.*, the ultimate unit of time is the time  
during which motion exists in an atom prior to its  
division from another atom, in a case of division  
due to motion ). The Sāṅkhya, we have already  
seen, determines this ultimate unit by reference to  
the motion of a Tanmātra.

The number of such units will determine the  
time-interval between a given set of physical condi-  
tions and a particular effect, for between a so-  
called sum of causes and a so-called sum of effects,  
there intervenes a series of atomic (or molecular)  
motions, with conjunctions and disjunctions which  
form the causal chain. However crude in the  
practical application, the fundamental idea is, in  
connection with the principle of work and energy  
( for which both the Sāṅkhya and the Nyāya-  
Vaiśeṣika furnish a rudimentary basis), immensely  
suggestive of a possible Time Calculus.

Plurality of Causes :—This will be discussed,  
when we consider the relation of Vyāpti to the  
principle of Causality.

The Nyāya Ground of Inference—Vyāpti निवृत्त-  
साधक्य—Vāchaspati) :—Inference, then, in the  
Nyāya, depends on the ascertainment, not of the  
causal relation, nor of the relation of genus to species,  
but of a natural relation, between two phenomena,  
of invariable and unconditional concomitance

(उपाधिविधुरः स्वाभाविकः सम्बन्धः व्याप्तिः—Udyotakara and Váchaspati). Of the two phenomena so connected, one is called the Vyápya or Gamaka (the sign, mark or indicator), and the other Vyápaka or Gamya (the thing signified, marked, or indicated). In the relation of fire and smoke, for example, smoke is the Vyápya or Gamaka (sign or mark); and fire, the Vyápaka or Gamya (the thing signified or marked). Now the relation of Vyápti between *A* and *B* may be either unequal or equipollent (विषमव्याप्ति or समव्याप्ति). When *A* is the sign of *B*, but *B* is not the sign of *A*, the Vyápti is one-sided or unequal, and here a Vyapti is said to exist between *A* and *B*, but not between *B* and *A*. For example, smoke is a sign of fire, but fire is not universally a sign of smoke. When, therefore, the relation of Vyápti is an unequal one, as between smoke and fire, it is expressed in the proposition :—Wherever the Vyápya (sign or mark, *e.g.*, smoke) exists, the Vyápaka (the thing signified or marked, *e.g.*, fire) also exists. From this it follows by necessary implication (a sort of चर्चापत्ति) that whenever the Vyápaka (*e.g.*, fire) is absent, the Vyápya (*e.g.*, smoke) is also absent (व्यापकाभावे व्याप्याभावः). Again, the Vyápti may be a mutual or equipollent one, *i.e.*, *A* and *B* may be signs of each other, *e.g.* green-wood fire and smoke. Here each in turn is Vyápya and Vyápaka, and this is expressed in

the two propositions :—(1) Wherever there is smoke, there is green-wood fire, and (2) wherever there is green-wood fire, there is smoke. By necessary implication it follows—(1) where there is no green-wood fire, there is no smoke ; (2) where there is no smoke, there is no green-wood fire. We have seen that a Vyápti exists between smoke and fire, for wherever there is smoke, there is fire. But we cannot say that a Vyápti exists between fire and smoke, for we cannot say that wherever there is a fire, there is smoke. The combustion of an iron-ball ( अग्निगोचक ), for example, is a case of fire without smoke. But it would be correct to say that a Vyápti exists between green-wood fire and smoke, as well as between smoke and green wood fire. The question, therefore, is—What is the relation between fire and smoke ? The relation between fire and smoke is a conditional relation ; *i. e.*, on condition that the fire is green-wood fire, it would be a sign of smoke. In other words, a Vyápti implies unconditional invariable concomitance, and the relation between fire and smoke is not therefore a Vyapti (natural unconditional concomitance), for fire requires a 'condition,' Upádhi, *viz.*, green-wood, to be followed by smoke. Smoke, on the other hand, requires no 'condition' to indicate fire. For the purposes of Inference, therefore, relations between phenomena may

be considered as of two kinds:—(1) Contingent conditional relations, holding good on the fulfilment of a certain condition or Upádhi, and (2) Vyápti, or unconditional invariable relation, between a mark and that which it marks, a relation without any Upádhi or determining condition (उपाधिविधुरः सन्धः). It is this latter kind of relation that serves as the ground of Inference. If we can ascertain that a Vyápti exists between *A* and *B*, then *A* is a sign of *B*, and an inference of the presence of *B* from the presence of *A*, and of the absence of *A* from the absence of *B*, would be warranted. The question, therefore, is—how to ascertain the relation of Vyápti between two phenomena.

Ascertainment of Vyapti according to the early Nyáya (आसिद्धीपाद्य).—Briefly speaking, the observation of agreement in presence (सन्धः) as well as agreement in absence (व्यतिरेकः), between two phenomena, with the non-observance of the contrary (अभिचारादर्शनम्), is the foundation of our knowledge of Vyápti (दर्शनादर्शने—Váchaspati). This suggests a natural relation (स्वाभाविकसन्धः—Váchaspati) of invariable concomitance (निवृत्तसादृश्यम्—Váchaspati) between the phenomena, which is fortified by our non-observance (अदर्शनम्) of the contrary (अभिचारः). But this does not establish the unconditionality of the concomitance (उपाधिविधुरसन्धः), which is essential to a Vyápti. We have therefore to examine the cases carefully

to see if there is any determining condition (Upádhi—*i. e.* some hidden or undetected but really operative or indispensable accompaniment) which conditions the relation between the supposed sign or mark (Gamaka) and the supposed signate (thing signified, Gamyā). Now let us consider what constitutes an Upádhi. It is a circumstance which always accompanies, and is always accompanied by, the supposed signate (the thing signified, Gamyā), but does not invariably accompany the supposed sign or mark (Gamaka). If, therefore, in the set of positive instances where both the sign and the signate are present, nothing else is constantly present, there can be no Upádhi. Or, again, if in the set of negative instances where both the sign and the signate are absent, no other material circumstance is constantly absent, there is no Upádhi. This follows from the very definition of an Upádhi. It is impracticable to fulfil these requirements rigorously. Still, every one of the accompanying circumstances (of course the likely ones) may be taken successively, and it may be shown that the concomitance continues even when the suspected Upádhi (ब्रह्मिणेयादि) is absent, and therefore it cannot be the Upádhi. And this is to be fortified by the observance of uniform and uninterrupted agreement in absence (Vyatireka) between the two concomitant phenomena. In this way, when we have disproved all

suspected Upādhis, we conclude by establishing the Vyápti. It is true that we may still go on doubting. But doubt has a certain limit for the 'experimenter' and the thinking person (परीक्षक, प्रेक्षकान्). When doubt overthrows the foundation of all rational practice (प्रासादिकलोकयाम्), or leads to a stoppage or arrest of all practical activity (लोकव्यवहारा), it stands *ipso facto* condemned, and must be abandoned (व्याघातावधिरासम्). Śrīharsha and Udayana—व्याघात is mentioned by Vāchaspati). Thus it is that Vyápti is ascertained. In this way, we observe innumerable instances of Vyápti. Now by means of repeated observations of this kind (भूयोदर्शनम्), we have established the principle of the Uniformity of Nature (समान-प्रतिबन्ध), and also of Causality; and these two principles thus ascertained may be made use of in their turn as the basis of an argumentation or deduction (Tarka, U'ha, तर्क) to confirm a particular Vyápti in a particular case. Tarka or U'ha, then, is the verification and vindication of particular inductions by the application of the general principles of Uniformity of Nature and of Causality, principles which are themselves based on repeated observation (भूयोदर्शनम्) and the ascertainment of innumerable particular inductions of uniformity or causality (भूयोदर्शनम् जनितसंस्कारवहितम् इन्द्रियमेव सामादिकसम्बन्धवादी—Vāchaspati). Thus Tarka also helps in dispelling doubt (सन्देह). Śrīharsha,

however, questions the validity of this verification, —cf. the well-known couplet ending तर्कः सदावधिः कृतः ।

It will be seen that the process of disproving all suspected Upádhis (उपाधिसङ्कानिरास), in the early Nyáya, answers exactly *as a process* to Mill's Method of Agreement. In fact, the disproof of a suspected Upádhi by pointing to instances of Agreement in presence (सन्वय) even in the absence of the Upádhi, fortified as this is by the instances of agreement in absence (व्यतिरेक), virtually amounts to Mill's Joint Method of Agreement. But the fundamental difference is this :—Mill's Method of Agreement is formulated in view of the phenomena of causation (including co-effects, etc.) and, as usually enunciated, confessedly breaks down in dealing with cases of Uniformities of Co-existence unconnected with Causation; the Nyáya Method based on the disproof of suspected Upádhis is a more daring and original attempt, and is far more comprehensive in scope, being applicable to all Uniformities of Co-existence and of Causation alike. And this the Nyáya successfully accomplished, by introducing the mark of unconditionality (उपाधिविधुरता) into the relation of Vyápti (Concomitance), even as the same mark of unconditionality (वन्वयाद्विनिश्चयता) had been previously intronuced into the definition of Causality (कार्यकारणभाव). The difference between the early Nyáya and the Buddhist systems

may be briefly put thus :—The former relied on empirical induction based on uniform and uninterrupted agreement in Nature, and accordingly regarded the Method of Agreement as the fundamental Method of Scientific Induction, founding Inference on Vyápti to which they subordinated Causality in the doctrine of Method ; the latter assumed two *a priori* principles, viz., causality and identity of essence, deduced the canon of the Method of Difference by an indirect proof from the principle of causality, and made this Method the foundation of all scientific Induction of Causality, just as they based all natural classification of Genera and Species on their *a priori* principle of Identity of Essence.

[Texts from the early Nyáya :—

Method of Agreement and the Joint Method without the device of the Upádhi :—

Cf. Jayanta on सङ्गच्छ्य—तस्मिन् सत्येव भवने न विना

भवने ततः । अयमेवाविनाभावो नियमः सङ्गच्छारिता । 'तस्मिन् सत्येव'  
'only this remaining throughout', while others change—implying the Method of Agreement. The set of positive instances, in which this antecedent alone is constant, must be supplemented by a set of negative instances (agreement in absence) :— व्यतिरेकनियमनरीच  
प्रतिबन्धवद्वयानुपपत्तेः । नियमसाधं उच्यते यत् तस्मिन् सति भवने ततो  
विना न भवने इति न्यूयद्वयेन । तच्च तस्मिन् सति भवने इत्यन्वयना-

अपरिच्छेदात् अद्वयहीतो नियमः स्यात् । ततो विना न भवन इत्यस्य  
अर्थस्य अपरिच्छेदात् इति Jayanta, A'hnika II, व्यतिरेकव्याप्ति-  
नियमावग्रहकत्वम् ।

Doctrine of the Upádhi :—Unconditional con-  
comitance distinguished from conditional :—

यो वा स वा असु सम्बन्धः यस्य असौ स्वाभाविकी नियतः स एव नमकः,  
गम्यस्य इतरः सम्बन्धीति युज्यते । तथा हि धूमादीनां वज्रादिसम्बन्धः  
स्वाभाविकः । नतु वज्रादीनां धूमादिभिः । उपलभ्यन्ते ते हि विनापि  
धूमादिभिः । यदातु आर्द्रैश्वनादिसम्बन्धम् अनुभवन्ति तदा धूमादिभिः सह  
संबध्यन्ते । तस्मात् वज्रादीनाम् आर्द्रैश्वनाद्युपाधिप्लवः सम्बन्धी न स्वाभा-  
विकः । ततो न नियतः । स्वाभाविकस्तु धूमादीनां वज्रादिसम्बन्ध उपाधिः  
अनुपलभ्यमानात् क्वचित् व्यभिचारस्य अदर्शनात् अनुपलभ्यमानस्यापि  
कल्पनानुपपत्तेः । अतो नियतः सम्बन्धः अनुमानाकम् ।

Concomitance sufficient without causal *nex-*  
*us* :—

The Buddhist objects—In Nature, everything is  
connected with everything else. Hence if there  
were no *nexus* of causality between antecedent  
and consequent, everything might follow from  
everything else. The Nyáya replies—You admit  
uniformities ( of co-existence, etc. ) other than  
causal ;—so you confess that a natural fixed order  
can exist without the causal *nexus*.....

An Upádhi, how established and how dis-  
proved :—

The Nyáya then proceeds to show how an Upádhi

is established, or how disproved by observation :—

तत्र वक्त्रेः अनाद्रेत्यस्य विना धूमम् अयोगोलकादौ दर्शनात् आद्रेत्यनी-  
पाधिः अस्य धूमेन सम्बन्धः न तु स्वाभाविक इति निश्चीयते । धूमविशेषस्य  
तु विना वक्त्रम् अनुपलब्धात्, उपाधिभेदस्य च अदृश्यमानस्य कल्पनायां  
प्रमाणाभावात्, विशेषवृत्त्यपेक्षस्य च संशयस्य अनुपलब्धपूर्वम् अनृत-  
पादात्, उत्पादे च अतिप्रसङ्गात् प्रेषावत् प्रवृत्त्याच्चेदात्, स्वाभाविकः  
सम्बन्धः अवधार्यते ।

General Method of Induction by exhaustion of the Upādhi, more comprehensive than Mill's Joint Method :—

For the definition of an Upādhi, vide Śrīharsha and Udayana: अव्यामृताधनो यः नाध्यसमव्याप्तिः उच्यते स उपाधिरिति । Hence to avoid an Upādhi ( which is नाध्यसमव्याप्तिः ), the constant presence of anything relevant other than the sign and the signate in the positive instances ( of agreement in presence, सन्धेय ), and the constant absence of any such thing in the negative instances ( of agreement in absence, व्यतिरेक ) must be safe-guarded against. This amounts to Mill's Joint Method.

Suspicion of non-perceptible Upādhi—Limits of legitimate Doubt :—

न च अदृश्यमानोऽपि दर्शनानर्हंतया सावकवाचकप्रमाणाभावेन  
संदिग्धमान उपाधिः स्वाभाविकत्वं प्रतिबध्नाति इति साम्प्रतम् । अवर्णा-  
-वृत्त्या भवितव्यं निशानकाभावादिति दत्तावज्ञाया खलु ईयम्  
प्रमाणावर्णादादिक्रमेण ब्रह्मा पिशाचो लब्धप्रसरा न कश्चित् नासीति नेयं

कश्चित् प्रवर्तेत । सर्व्वमेव कस्यचित् कश्चित् अनर्थस्य ब्रह्मास्यदत्तात् । अनर्थब्रह्मायाश्च प्रेक्षावता निवृत्ताङ्गत्वात् । अतः सिद्धान्तपानीपयोनिषु अपि मरणादिदर्शनात् । तस्मात् प्रामाणिककक्षीकयात्राम् अनुपालयता यथादर्शनं ब्रह्मणीयम् । ..... तन्मातृपाधिं प्रयत्नेन अस्तिव्यक्तोऽनुप-  
लभमाना नास्तीति अवश्यम् स्वाभाविकत्वं सम्बन्धस्य नियमितम् ।—

Tarka, U'ha,—Deductive verification of particular inductions by applying the two fundamental inductions of Uniformity of Nature, and Causality :—Doubt finally dispelled :—

Now innumerable particular uniformities of this kind ( Vyáptis ) are observed, and as a result of this repeated observation, a belief in the Uniformity of Nature ( स्वभाव प्रतिबन्ध ), as well as in the principle of Causality ( कार्यकारणभाव ) is generated in the mind, a belief which has evidential value and validity. It is not intuition ( न ज्ञानसम् ) but a mental pre-disposition based on uniform and uninterrupted experience ( भूयोदर्शनजनितसंस्कारसहितम् इन्द्रियमेव स्वाभाविकसम्बन्धश्चादि, —अथ भूयोदर्शनम् असाधारणम् इति प्रमाणात्तदं जातम् ). Then armed with these new resources, the belief in uniformity and in causality as general principles, we proceed to fortify our particular inductions ( Vyáptis ), whether of uniformity of nature or of causality, by indirect deduction from these general principles :—We argue if, under these observed circumstances, *A* were not the mark of *B*, the principle of uniformity of nature would be violated,—Nature would not be uni-

is established, or how disproved by observation :—  
 तत्र वक्त्रेः अनार्द्रं न्यूनस्य विना धूमम् अयोगीशकादौ दर्शनात् आर्द्रं न्यनी-  
 पाधिः अस्य धूमेन सन्त्यः न तु स्वाभाविक इति निश्चीयते । धूमविशेषस्य  
 तु विना वक्त्रम् अनुपलब्धात्, उपाधिभिदस्य च अदृश्यमानस्य कल्पनायां  
 प्रमाणाभावात्, विशेषकृत्यपेक्षस्य च संशयस्य अनुपलब्धपूर्वम् अनुत्-  
 पादात्, उत्पादे च अतिप्रसङ्गात् प्रेषावत् प्रवृत्त्युक्तेदात्, स्वाभाविकः  
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form,—or, if under these observed circumstances *A* were not the cause of *B*, the principle of causality would be violated, the phenomenon *B* would be without a cause ;—and such indirect proof (तर्क, ऊह) gives us the overwhelming probability which we call practical certitude, and on which every reasonable man (every thinking and judging person) proceeds to act in due natural course.—

स्वभावस्य प्रतिबन्धा हेतवः स्वसाध्येन, यदि साध्यमन्तरिण भवेयुः, स्वभावादेव प्रत्यक्षेण तर्कसहायः अनिरससाध्यव्यतिरेककल्पसिद्धेया यत्र दृष्टाः, तत्र स्वसाध्यम् उपस्थापयन्ते । Vāchaspati I, 1, Sutra 5 ; cf. also, I, 1, Sutra 40— ऊहः कारकस्योपपत्त्या संभवेन ज्ञायते । कारकस्यैव कार्यस्य असत्त्वात् ।]

Instances of Vyāpti (uniformity) not comprehended under Causality, or the relation of Genus and Species :—The Nyāya points out that the relations of cause and effect and of genus and species do not exhaust the grounds of Inference. There are cases of Inference based on Vyāpti (i.e., on invariable and unconditional concomitance) which come neither under Causality (तदुत्पत्ति) nor under Identity of Essence (तादात्म्य). Vāchaspati notes that to-day's sunrise and yesterday's sunrise, the rise of the moon and the tide in the ocean, the relative positions of the stellar constellations, are instances of Vyāpti (invariable concomitance) between phenomena which are neither related as cause and effect, nor as genus and species. Jayantā adds the conjunction of sun-set with the appearance of the stars,

of ants moving in procession (with their eggs) with the approach of the rains,—of the rising of the constellation Agastya (Canopus) above the horizon with the drying up of rivers; of the springtide with the full moon; and dismisses as sophistical and far-fetched the Buddhist attempt to explain all these cases by means of causality. We have seen that the Nyáya and the Mīmāṃsā reduce most of these conjunctions to cases of co-effects of the same cause, co-effects which may be either simultaneous or successive.

अपि च अद्यतनस्य सवितुरुदयस्य ह्यस्तमेन सवितुरुदयेन, चन्द्रीदयस्य च समानकालेन समुद्रवृद्ध्या.....न कार्यकारणभावः तादात्म्यं वा । अथ च दृष्टीगम्यगमकभावः ।—Vāchaspati, Tātparyya-Tikā I, 1, Sutra 5;—cf. also Jayanta, Nyāya Manjarī—अन्वेयानपि ईदृशी भूमी जगति दृश्येतात् । सूर्यास्तमयमासीक्य कल्पते तारकीदयः । पूर्वाचन्द्रीदयाह्निरस्तुधेवमस्यते । उदितेनानुनीयन्ते सरितः कुक्ष्योगिनः । शुष्यत्पुलिनपर्यन्तं विश्रान्तखगपंक्तयः । विवीक्षितान्सुखारवेष्टानु-मितवृष्टयः । भवन्ति पथिकाः पर्वकुटीरवारणीदराः ।

Vyāpti between Cause and Effect :—Relation of causality to Vyāpti :—

On the Buddhist ( and early Nyāya ) view that one specific assemblage of 'effect' phenomena has one specific assemblage of causal conditions, there would be two aggregates, the sum of causal conditions ( कारकसामग्री ), and the sum of effects ( काये-सामग्री ). For example, fire requires green-wood to complete the sum of causal conditions to give rise to smoke with some particular marks ( धूमविशेष,—

बहुलपाण्डुतादिचर्मा विविष्ट, Jayanta II ; compare Gangesa, कथागुरुप्रभववर्जितानयं कटुकादुरभिपाण्डुरधूसवत्त्वात् ।—Chintámani, Anumana, Viruddha Siddhánta). Here, between an effect and a single condition (termed a cause) there is a relation of Vyápti. The effect is Vyápya or Gamaka (the sign or mark) ; the cause (or condition) is Vyápaka or Gamya (the thing signified). In other words the presence of the effect indicates the presence of the causal condition, and the absence of the causal condition will by implication indicate the absence of the effect. Smoke of this particular kind is supposed to be an effect of which there is one and only one assemblage of causal conditions ( fire and green-wood) ; hence where there is smoke, there is fire ; and when there is no fire, there is no smoke.

Now introduce the complication of the plurality of causes :—Fire, for example, is the effect of several assemblages, *e.g.*, (1) blowing on heated grass, (2) focussing rays through a lens on a combustible like paper or straw, (3) friction with the fire drill, etc. Here each assemblage is regarded as a sum of causes. But in this case there is no Vyápti between the effect 'fire' and any particular assemblage of causal conditions, say, of the lens or the fire drill. For the presence of fire does not indicate the presence of the lens or the fire drill assemblage, nor does the absence of either of the latter in particular, indicate the absence of fire.

Indeed in such a case, the effect 'fire' is not a mark or sign ( Gamaka or Vyápya ) of any one in particular of the different possible causal assemblages, though each of these particular assemblages of causal conditions is a mark or sign ( Gamaka or Vyápya ) of fire.

The plurality of causes requires a further consideration in the light of the definition of the causal relation. A cause is defined to be the unconditional invariable antecedent. From the unconditionality, it follows that the entire sum of conditions, and not one single condition, is, properly speaking, the cause. In view of the plurality of causes, an invariable antecedent must be taken to mean that any particular cause (*i.e.*, assemblage of causal conditions ) is invariably followed by the effect,—not that the effect is invariably preceded by any particular cause.

Popularly, a single condition, say the lens or the fire-drill, is said to be a cause of fire ; but, in view of the plurality of causes, this is apt to be misleading, as there is no Vyápti in this case ; the lens or the fire-drill is no more a mark of fire than fire is a mark of the lens or the fire-drill.

The plurality of causes strains the definition of a cause, and undermines the relation of Vyápti between an effect and a cause. Any particular cause (causal aggregate) still indicates the effect, but not *vice versa*. The earlier Nyáya (down to

Váchaspati and Jayanta ) obviated the plurality, as we have seen, by introducing distinctive marks in the effect such as would indicate a single specific cause ( कार्यवैलक्षण्य or कार्यभेद indicating कारणवैलक्षण्य or कारणभेद ). Some indeed went further and held that when the antecedent causal assemblages differ in kind, the effect phenomena, though apparently the same, do really differ specifically ( or in kind )—कारणवैजात्यात् कार्यवैजात्यम् । But the Nyáya discards this hypothesis ; the fire is the same, though the possible causes ( or causal aggregates ) differ, *e.g.*, the lens, the drill, etc. But the effect phenomenon to which we attend is not the only effect ;—in the case of plurality of causes, we must carefully examine the accompaniments of the effect, *i.e.*, the sum of effects, and the examination will shew some distinctive or specific circumstance or accompaniment which will enable us to definitely determine the particular assemblage of causal conditions that must have preceded in the case under examination. This is the device of the earlier Nyáya as well as of the Buddhists, as we have seen ; but the later Nyáya doubts the practicability as well as the theoretical validity of such a step on an unrestricted assumption of the plurality of causes, and feels troubled by the circumstance that no effect for which more than one cause ( or causal aggregate ) can be assigned, can be regarded as a mark or sign ( Gamaka or Vyápya ) of any one of

the causes in particular. Accordingly, some adherents of the later Nyáya advanced the proposition that when more than one causal aggregate can be supposed for any effect, the latter is a mark or sign ( Gamaka or Vyápya ), not of any one of the causal aggregates in particular, but of one or other of them ; and the absence, not of one such cause, but of each and every one of them, alone indicates the absence of the effect. A cause therefore should be defined to mean *one or other* of the possible alternative aggregates which, being given, the effect follows invariably and unconditionally. If we ask what is the defining mark (or quiddity) of the cause ( कारणतावच्छेदक ), we are told that it is *one-or-otherness* ( अन्यतमत्व ), and nothing else : others cut the Gordian knot by assuming that the different possible causes of the same effect possess a common power or efficiency\* ( अतिरिक्तशक्ति ), or a common 'form' ( जातिसौम्य ), which accounts for the production of a common effect. The latter is therefore a sign or mark of this power ( शक्ति ), or this form ( जातिसौम्य ), which is manifested by each of the causal aggregates.† This hypothesis ( कल्पना ), they hold, is simpler and more plausible than the hypothesis of specific differences latent in the apparently identical effect of a plurality of causes ( कारणवैजात्यात् कार्यवैजात्यम् ).

(Cf. Dinakari on the Siddhanta Muktavali—कविज्ञ  
वक्तिं प्रति दृष्टफत्कार-संयोगादीनां दृष्टफत्कार-संयोगत्वादिरूपेण

कारणतया व्यभिचारं च सम्भवात् अतिरिक्तशक्तिविधिः । न च  
 तदुक्तकारणीः अरणिर्निर्न्याः अतएव अतिरिक्तशक्तिरप्यस्य सम्बन्धस्य  
 अन्यतावच्छेदकं ब्रह्मविज्ञानात्यन्तं कल्पमिति न व्यभिचार इति वाच्यम् ।  
 तद्वन्वतावच्छेदकवैजात्ययकल्पनामपेक्ष्य तन्तत्सम्बन्धानां एकशक्तिमत्त्वेन  
 कारणत्वकल्पनाया एव लक्षणेन व्याख्याता इत्याहुः । तत्र ।... अन्यतमत्वेन  
 कारणतासम्भवात्..... परे तु तद्वादिष्वन्वकाशीनवायसंयोगादीनां एक-  
 शक्तिमत्त्वेन हेतुतामादाय विनिगमनाविरहात् न शक्तिसिद्धिः इत्याहुः ।  
 Sloka 2, cf. also, तद्वारणिमण्यन्यतमत्वं कारणस्य विनिगमनम् ।

Cf. Udayana, Kusumánjali, Stavaka I—कथं तदि  
 तद्वारणिमण्यभ्यो भवन्नाद्यद्युच्चिरेकजातीयः । एकशक्तिमत्त्वात्  
 इति चेत् न । यदि हि विजातीयेषु अपि एकजातीयकार्यकारण-शक्तिः  
 समवेद्यात्, न कार्यात् कारणविशेषः कश्चित् अनुमीयत । कारणव्यावृत्त्या च  
 न तज्जातीयस्यैव कार्यस्य व्यावृत्तिरवसीयत ।..... एतेन सूक्ष्मजातीयमिति  
 निरस्तम् । अथरूपेण तत्त्वैवात् धूमोत्पत्त्यापत्तेः ।

The Scientific Methods already noticed, the Joint Method of Difference ( the Panchakárani ), and the Joint Method of Agreement ( Vyáptigraha with Upádhisanká-nirasa and Tarka ), are not the only methods of ascertaining causality or concomitance, or establishing a theory ( सिद्धान्त ) ; nor are these Methods always practicable. Very often, we reach the explanation of a fact ( उपपत्ति ) by means of a Hypothesis ( कल्पना ) properly tested and verified ( निर्वीत ). A legitimate Hypothesis must satisfy the following conditions :—(1) the hypothesis must explain the facts ( दृष्टसिद्धि, or उपपत्ति ) ; (2) the

hypothesis must not be in conflict with any observed facts or established generalisations (इष्टविषयं हि षट् कल्पते, न ह्यष्टविधासाध—Jayanta, Nyāya-Manjari, Ahnika 1); (3) no unobserved agent must be assumed, where it is possible to explain the facts satisfactorily by observed agencies (यदि षट्कर्मक्षरेषु दृष्टं न सिद्ध्यति कानमदृष्टं कल्पताम्, अन्यथापि तदुपपत्तौ किं तदुपकल्पनेन, *ibid*); (4) when two rival hypotheses are in the field, a crucial fact or test (विनिगमक, *ratio sufficiens*) is necessary; the absence of such a test (विनिगमनाविरह) is fatal to the establishment of either, (5) of two rival hypotheses, the simpler, *i.e.*, that which assumes less, is to be preferred (*ceteris paribus*) (कल्पनालक्ष्य versus कल्पनागौरव); (6) of two rival hypotheses, that which is immediate or relevant to the subject-matter is to be preferred to that which is alien or remote (प्रसंगीपक्षितत्व); (7) a hypothesis that satisfies the above conditions must be capable of *verification* (निर्णय) before it can be established as a theory (सिद्धान्त). The process of verification of a hypothesis consists in showing that it can be deduced as a corollary from (or is involved by implication in) some more general proposition which is already well-established (cf. Vatsyayana's exposition and illustration of Verification, निर्णय,—including both the Deductive Method and Colligation).

This doctrine of Scientific Method, in Hindu Logic, is only a subsidiary discipline, being com-

prehended under the wider conception of Methodology, which aims at the ascertainment of Truth whether scientific (Vijnana) or philosophical (Jnana) (नौचं चीजान् स्यात् विज्ञानं शिष्यशास्त्रयोः, Amara-Kosha);—the latter being the ulterior aim. In the investigation of any subject, Hindu Methodology adopts the following procedure: (1) the proposition (or enumeration) of the subject-matter (Uddesa), (2) the ascertainment of the essential characters or marks, by Perception, Inference, the Inductive Methods, etc.,—resulting in definitions (by लक्षण) or descriptions (by उपलक्षण); and (3) Examination and Verification (परीक्षा and निश्चय). Ordinarily the first step, Uddesa, is held to include not mere Enumeration of topics, but Classification or Division proper (विभागः लक्ष्यव्यापकपादासु लक्ष्येण एवासीत्। सामान्यसंज्ञया कीर्तनमुद्देशः प्रकारभेदसंज्ञया कीर्तनं विभाग इति—Jayanta, Manjari); but a few recognise the latter as a separate procedure coming after Definition or Description. Any truth established by this three-fold (or four-fold) procedure is called a Siddhānta (an established theory). Now the various Pramānas Poofs, *i.e.*, sources of valid knowledge) in Hindu Logic, *viz.*, Perception, Inference, Testimony. Mathematical Reasoning (सम्पन्न, including Probability in one view) are only operations subsidiary to the ascertainment of Truth (तत्त्वनिर्णय). And the Scientific Methods are merely ancillary to these Pramānas themselves.

I have explained the principles of the Hindu doctrine of Scientific Method, avoiding the technicalities of Logic as far as possible ; and I cannot here enter upon the logical terminology or the logical apparatus and machinery, which would require a separate volume to themselves. For these, I would refer the reader to my paper on Hindu Logic,—as also for an account of the later Nyáya (न्याय), which, in spite of its arid dialectics, possesses a three-fold significance in the history of thought : (1) logical, in its conceptions of Avachchhedaka and Pratiyogi, being an attempt to introduce quantification on a connotative basis, in other words, to introduce quantitative notions of Universal and Particular, in both an affirmative and a negative aspect, into the Hindu theory of Inference and Proposition regarded connotatively as the establishment of relations among attributes or marks ; (2) scientific, in its investigation of the varieties of Vyápti and Upádhi, (and of न्यायसिद्धि) being an elaboration of Scientific Method, in the attempt to eliminate the irrelevant ; and (3) ontological and epistemological, in its classification and precise determinations of the various relations of Knowledge and Being, with even greater rigidity and minuteness than in Hegel's Logic of Being and Essence. I will conclude with a few observations on Applied Logic, *i.e.*, the logic of the special sciences, which is such a

characteristic feature of Hindu scientific investigation. What is characteristic of the Hindu scientific mind is that without being content with the general concepts of Science and a general Methodology, it elaborated the fundamental categories and concepts of such of the special sciences as it cultivated with assiduity, and systematically adapted the general principles of Scientific Method to the requirements of the subject-matter in each case. The most signal example of applied logic (or Scientific Method) worked out with systematic carefulness is the Logic of Therapeutics in Charaka, a Logic which adapts the general concepts of cause, effect, energy, operation, etc., and the general methodology of science, to the special problems presented in the study of diseases, their causes, symptoms and remedies (*vide* Charaka, Vimānasthāna, Chap IV,—<sup>\*</sup>also Sutra Sthāna,—*vide* my Paper on Hindu Logic). Here I will give an illustration of Applied Methodology from the Science of Analytical and Descriptive Grammar. Patanjali, in the Mahābhāṣya, is very careful as regards Methodology. I take no note now of the philosophical presuppositions of his philology (*vide* my Paper on the Hindu Science of Language), but will confine myself to his presentation of the Applied Logic of Descriptive and Analytical Grammar. The sentence is the unit of speech, as every Hindu philologist contends, but the first business of Analytical

Grammar is to analyse the sentence into its significant parts and their coherent relations to one another. Assuming that articulate sounds are significant, the question is:—how is the sentence, which is the unit of articulate speech, broken up into significant words and their mutual relations? Patanjali answers that this is done by an instinctive use (cf. Vāchaspati's भूतो दर्शनजनितसंस्कारम् इन्द्रियम्) of the Joint Method of Difference (combined Addition and Subtraction), fortified by the Joint Method of Agreement (अनुव्यतिरेकी). Patanjali starts with a simple case. Take the two sentence-units:—Pathati (he reads) and Pachati (he cooks). Suppose you start with the assumption that these sounds are significant, and *that separate elements have separate meanings*. Then you hear Pathati, and, at the same time, a man reading is pointed at. Then the assemblage of sounds Pathati (*i. e.*, Path+ati) stands for the assemblage—'one reads,' (*i. e.* the action reading+an individual agent). Similarly by finger-pointing or other indication, you find that the assemblage Pachati (*i. e.* Pach+ati) stands for the assemblage 'one cooks' (*i. e.* the action cooking +an individual agent, say, the same agent as before).

Now look at the groupings:—

Path + ati = reading + one agent.

Pach + ati = cooking + one agent.

From repeated observation of similar groupings, one is led to conclude that Path is the invariable concomitant of the action 'reading', because the disappearance of the former (the other element remaining) leads to the disappearance of the latter (a rough Method of Difference by subtraction—हीयते) ; that Pach is the invariable concomitant of the action 'cooking' because the introduction of Pach (with nothing else added) leads to the introduction of the action 'cooking,' (a rough Method of Difference by addition,—उपजायते) ; and that Ati, which is the only 'common antecedent' (अनुद्यो) is the invariable concomitant of 'one agent' which is the only common 'consequent' (अनुद्यो) . In fact, the last should come first by the Method of Agreement, then the other two either by Residue, or by Joint Agreement in presence and absence (अनुद्यव्यतिरेकी) . So far all is plain sailing, though only very simple and very rough applications of the Methods are given. But—and this is the point—throughout the argument, it is assumed that one sound is the concomitant of one idea, in other words, there is no plurality of causes to vitiate the application of the Method of Agreement in the above example. And now the objection is advanced that this basal assumption is untrue. The same sound is not the concomitant of the same idea. Different words (sounds) may have the same meaning, and the same word (sound) may have

different meanings. We cannot therefore by the Joint Method of Agreement (अनुव्यतिरेको) determine the meanings of words, or the separate functions of roots (stems) and inflections,—at least not so simply as is pretended above. Patanjali states this difficulty in the way of applying the Scientific Methods to the problems presented by Analytical Grammar, a difficulty arising from the plurality of causes, but does not state the solution. The solution, however, depends on the Method of Subtraction and Addition (Patanjali's ह्यने and चयनाद्यने). For it will be found by extensive observation that the number of meanings of which a word (sound) may be capable is limited. So also is the number of words (sounds) expressive of a given meaning. Hence, by the Method of Difference, etc., the causal relations of words and meanings may be determined. Patanjali thus establishes the doctrine of Prakriti and Pratyaya (roots and inflections), with their separate significance, which is of course a necessary postulate in the case of an inflectional language like Sanskrit. Isolating and Agglutinative languages offer less difficulty, whereas the difficulties are in some respects enhanced in the case of languages with a polysynthetic or incorporating (incapsulating) morphological structure.

कथं पञ्चायते अर्थं पञ्चत्यर्थः अर्थं प्रत्ययार्थं इति । अनुव्यतिरेकाभ्याम् ।  
कोऽसौ अनुव्यो व्यतिरेको वा । इह पञ्चतीत्युक्तं कथितं शब्दः श्रूयते,

पठतीत्युक्तं कथित् शब्दो होयते ( पठ् ),—कथित् उपजायते ( पठ् ,—  
कथित् अनुयो ( वति );—अर्थोऽपि कथित् होयते ( विक्रिप्तिः ),—  
कथित् उपजायते ( पठिक्त्रिया ),—कथित् अनुयो ( कतृत्वं चेतत्वंच ) ।  
तत्र मन्वाभवे यः शब्दो होयते, तस्य असौ अर्थः योऽर्थो होयते । यः शब्द  
उपजायते तस्य असौ अर्थः योऽर्थः उपजायते । यः शब्दोऽनुयो तस्य असौ  
अर्थः योऽर्थोऽनुयो ।

विषय उपस्थापः—बहवो हि शब्दा एकार्था भवन्ति । तद्वयथा इन्द्रः  
ब्रह्माः पुरन्दरः । एकस्य शब्दो बह्वर्थः । तद्वयथा यथाः पादा माषा इति ।  
अथ किं न साध्वीयोऽर्थवत्ता सिद्धा भवति । नापि त्रूमीऽर्थवत्ता न  
सिध्यतीति । वणिता हि अर्थवत्ता अनुप्रत्यतिरिक्ताभ्यामेव । तत्र कुत  
एतदर्थं प्रकृत्यर्थः अर्थं प्रत्ययार्थ इति । ( Mahābhāṣya, 1—3, 9. )

Patanjali not only applies the Scientific Methods to the foundations of Grammatical Analysis, but also *by their means* establishes and elaborates the fundamental categories and concepts of Grammatical (and Philological) Science, *e.g.*, the concepts of action ( क्रिया ), agent ( कर्ता ), instrumental cause ( करण साधकतमम् ), end ( निमित्त ), origin ( हेतु ), limit ( अपधि ), substance ( द्रव्य ), quality ( गुण ), and genus ( जाति ); —also of the fundamental relations (at the bottom of all thought and *speech*)—the relations of Time ( कालिकसम्बन्ध ), of Space ( दिग्देशसम्बन्ध ), of Causality ( कार्यकारणभाव ), of inherence ( अनुवाय , of co-inherence ( विशिष्यविशेष्यभाव ), of the sign and the signate ( संज्ञासंज्ञिभाव ), of mutual dependence ( इतरैतराश्रय );—an entire grammatical (and philological) apparatus, which will serve as a '*point d'appui*' for generations of philologists and grammarians to come.

## ADDENDA.

( BY PRINCIPAL BRAJENDRANATH SEAL. )

*Empirical Recipes from Varáhamihira ( circa 550 A.D. ) relating to Chemical Technology.*

A. Searing of hard rocks to enable them to be cut (or pulverised) ( शिलाहारण ).

Sprinkle on the rock taken red-hot from the fire of Palasa and Tinduka wood ( *Butea Frondosa* and *Diospyros Embryopteris* ) :—( *a* ) diluted milk, or ( *b* ) a solution of wood ashes (the ashes of the *Mokshaka* mixed with those of reeds), or ( *c* ) a decoction of (the fruit) of the jujube ( *Zizyphus Jujuba* ) kept standing for 7 nights in a mixture of whey, vinegar and spirits, in which *Kulattha* ( *Dolichos Uniflorus* or *Biflorus* ) has been steeped, or ( *d* ) a solution of the ashes of the *Neema* bark and leaves ( *Azadirachta Indica* ), the sesame pod, the resinous fruit of the *Diospyros Embryopteris*, and the *Guduchi* ( *Tinospora Cordifolia* ), with cow's wieve. Repeat the process seven times (in the last case six times).

( Varáhamihira, *Vrihat-samhitá*, Chap. 33,

Slokas 112-117).

### B. Hardening of steel ( **सखपात्र** ).

(1) Plunge the steel red-hot into a solution of plantain-ashes in whey, kept standing for 24 hours ;—then sharpen on the lathe.

(2) Make a paste with the juice of the Arka (*Calotropis Gigantea*), the gelatine from the horn of the sheep, and the dung of the pigeon and the mouse ; apply it to the steel after rubbing the latter well with (sesame) oil. Plunge the steel, thus treated, into fire ; and when it is red-hot, sprinkle on it water, or the milk of the horse (or the camel or the goat), or ghee (clarified butter), or blood, or fat or bile. Then, sharpen on the lathe.

( **Varāhamihira, खड्गलक्षणम्,**

chap. 49, slokas 23-26.

C. Preparation of cements (for rocks, metals, etc.) ( **वज्रसिद्धि** )—

Varāhamihira gives the following recipes among others. (1) First, prepare a levigated powder with lac, the resinous exudation of the *Pinus Devadara*, the *Balsamodendron Mukal*, the *Feronia Elephantum*, the kernel of the fruit of the *Ægle Marmelos* (the *bel*), the *Diospyros Embryopteris*, the *Neem* (*Azadirachta Indica*), the *Mhow* (*Bassia Latifolia*), the Indian madder (*Rubia Manjistha*), the *Phyllanthus Emblica*, and the resin of the *Sala tree* (*Shorea Robusta*), then make a decoction of this in 256 Palas of water reduced

by boiling to 32 Palas, and apply the decoction hot.

(2) The horns of cows, buffalos and goats, asses' hair, buffalo's skin, with *gavya* (cow's urine etc.), the Neem (*Azadirachta Indica*) and the *Feronia Elephantum*, similarly treated.

(3) A mixture of eight parts of lead, two of 'bell-metal' and one of brass, melted and poured hot (Maya's cement).

The first, it will be seen, has lac, gum and turpentine as principal ingredients; the second makes use of gelatine; and the third is a metallic cement.

D. Nourishment of Plants :—(from Varáha-mihirīa, Chap. 54, on वचायुज्जद).

The most suitable ground to plant in is soft soil that has been sown with the *Sesamum Indicum*, and dug up or trodden over with the sesame in flower. Grafts should be smeared with cowdung. For transplanting, the plants should be smeared with ghee (clarified butter), sesame oil, the honey of the Kshudra variety of the bee, the oil of the *Usira* (*Andropogon Laniger* or *Andropogon Citrarum*), the *Vidanga* (*Embelia Ribes*), milk and cowdung. Trees should be planted at intervals of 20 or 16 cubits.

As a sort of general prophylactic, mud kneaded with ghee (clarified butter) and *Vidanga*, (*Embelia Ribes*) should be applied to the roots, after which

milk diluted with water should be poured. As a remedy against barrenness, a hot decoction should be made of Kulattha (*Dolichos Uniflorus* or *Biflorus*), Masha (*Phaseolus Roxburghii*), Mudga (*Phaseolus Mungo*), Tila (*Sesamum Indicum*), and Yava (barley); which, when cooled, should be poured round the roots.

To promote inflorescence and fructification, a mixture of one A'dhaka (64 palas) of sesame, two A'dhakas (128 palas) of the excreta of a goat or sheep, one Prastha (16 palas) of barley powder, one Tula (100 palas) of beef, thrown into one Drona (256 palas) of water, and standing over for seven nights, should be poured round the roots of the plant. The measures given are for one plant.

To ensure inflorescence, etc., the seed before being sown should be treated as follows:—The seeds should be taken up in the palm greased with ghee (clarified butter), and thrown into milk;—on the day following, the seeds should be taken out of the milk with greased fingers, and the mass separated into single seeds. This process is to be repeated on ten successive days. Then the seeds are to be carefully rubbed with cowdung, and afterwards steamed in a vessel containing the flesh of hogs or deer. Then the seeds are to be sown with the flesh, with the fat of hogs added, in a soil previously prepared by being sown with sesame and dug up or trodden down.

To ensure the formation of Ballarís ( *i.e.*, sprouting and the growth of luxuriant stems and foliage ), the seeds should be properly soaked in an infusion of powdered paddy, *Masha* (bean), sesame and barley mixed with decomposing flesh, and then steamed with Haridra (turmeric). This process will succeed even with the Tintidí (Tamarindus Indica). For the Kapittha ( Feronia Elephantum ), the seeds should be soaked for about two minutes (lit. such length of time as it would take one to make a hundred rhythmic claps with the palms—तात्पर्यम् ) in a decoction of eight roots (A'sphota, A'malaki, Dhava, Vásika, Vetasa, Suryyavalli, Syáma and Atimukta, *i.e.*, the Jasmine, the myrobalan, the Grisea Tomentosa, the Justicia Ganderussa, the Calamus Rotang, the Gymandropsis Pentaphylla, the Echites Frutescens, and the Dalbergia Oujeinensis) boiled in milk. The seeds should then be dried in the sun. This process should be repeated for thirty days. A circular hole should be dug in the ground, a cubit in diameter and two cubits deep, and this should be filled with the milky decoction. When the hole dries up, it should be burnt with fire, and then pasted over with ashes mixed with ghee and honey. Three inches of soil should now be thrown in, then the powder of bean, sesame and barley, then again three inches of soil. Finally, washings of fish should be sprinkled, and the mud

should be beaten and reduced to a thick consistency, then the seed previously prepared should be placed in the hole under three inches of soil, and fish-washings poured. This will lead to luxuriant ramification and foliage, which will excite wonder. The Agnipurána adds that the mango is specially benefited by cold fish-washings ( मत्स्योदकेन शीतेन चास्मान्नी रीकः रच्यते—इत्याहुर्ब्रह्म, Agnipurána ). It will be seen that these elaborate recipes are empirical contrivances for supplying the requisite nitrogen compounds, phosphates and bacteria, these being potentially contained in the mixtures and infusions prescribed.

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# ERRATA.

PAGE. LINE.

|   |      |   |       |     |                                    |      |                                                      |
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| " | 62,  | " | 15    | for | करकचम्                             | read | वरकचम्                                               |
| " | "    | " | 23    | "   | रजजहदार.                           | "    | राजजाहदार:                                           |
| " | 73   | " | 22    | "   | सकचस                               | "    | सकुचस                                                |
| " | 79   | " | 7     | "   | वरिवास                             | "    | वरिनाच                                               |
| " | 84   | " | 26    | "   | सखवव                               | "    | vide सखवव                                            |
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| " | 124  | " | 22    | "   | Charaka and<br>Susruta             | "    | Charaka                                              |
| " | 133  | " | 12    | "   | cosmetics                          | "    | Perfumery                                            |
| " | 140  | " | 18    | "   | Tissues                            | "    | , —tissues                                           |
| " | 143  | " | 21    | "   | chyle                              | "    | chyme                                                |
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| " | 144  | " | 26    | "   | this tissue of the<br>flesh tissue | "    | this tissue. Of<br>the flesh tissue                  |
| " | 150, | " | 7     | "   | Appendix                           | "    | my Paper on<br>Hindu Ana-<br>tomy and<br>Physiology. |
| " | "    | " | 10    | "   | Appendix                           | "    | same paper                                           |
| " | 166  | " | 4     | "   | 62° Fahrenheit                     | "    | 86° Fahrenheit or<br>30° Centigrade                  |
| " | 175  | " | 23    | "   | चतव                                | "    | चेतव                                                 |
| " | 176  | " | 3     | "   | चतव                                | "    | चेतव                                                 |
| " | 189  | " | 11    | "   | These binary                       | "    | In Prasastapada's<br>view, these binary              |
| " | 203  | " | 9     | "   | true oils latter by                | "    | true oils                                            |
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| " | 221  | " | 1     | "   | a and codenstion                   | "    | and condensation                                     |
| " | "    | " | 23    | "   | Preface                            | "    | Introduction                                         |
| " | 223  | " | 26    | "   | Experiment as a<br>Scientific      | "    | Experiment as<br>an independent                      |

|     |        |              |                             |                   |                                                   |
|-----|--------|--------------|-----------------------------|-------------------|---------------------------------------------------|
|     | 26     | <i>for</i>   | विशेष                       |                   | विशेष                                             |
|     | 27     | "            | अथवावाचानु                  | "                 | अथवावाचानु                                        |
| 232 | 1      | "            | इति । किंचित् न ।           | "                 | इति चेत् न ।                                      |
| 243 | 16     | "            | a contradiction             | "                 | an unsettlement                                   |
| 246 | 9      | <i>after</i> | Bauddha Darsanam <i>add</i> | <i>vide</i>       | also Sridhara, Kandali                            |
|     | 14     | <i>omit</i>  | in the Mimansa.....         | पामाकारः          |                                                   |
| 255 | 25     | <i>for</i>   | भूतः                        | <i>read</i>       | भूतः                                              |
| "   | "      | "            | अनुपपन्नः                   |                   | अनुपपन्नेः                                        |
| 262 | 20, 25 | "            | non-observance              |                   | non-observation                                   |
| "   | 23     | "            | सम्बन्ध                     |                   | सम्बन्ध                                           |
| 264 | 28     | "            | वाची                        |                   | वाचि                                              |
| 270 | 27     | "            | ause cand effect            |                   | cause and effect                                  |
| 280 | 22     | <i>after</i> | Mahabhashya <i>add</i>      | (Circa 150 B. C.) |                                                   |
| 284 | 24     | "            | co-inherence                |                   | (सामानाधिकरण्य),<br>of substance<br>and attribute |
| 285 | 16     | <i>for</i>   | cow's wieve                 | <i>read</i>       | cow's urine                                       |

**SANSKRIT TEXTS.**



# Extracts from RASARATNAKARA.

नागार्जुन-विरचितात्

रसरत्नाकरादुद्धृताः श्लोकाः ।

अथ महारसशोधनं व्याख्यास्यामः ।

किमत्र चित्रं यदि राजवर्त्तकं

शिरीषपुष्पाग्रसेन भावितम् ।

सितं सुवर्णं तरुणार्कसन्निभं

करोति गुञ्जाशतमेकगुञ्जया ॥ १ ॥

राजावर्त्तशोधनम् ।

किमत्र चित्रं यदि पीतगन्धकः

पलाशनिर्ध्यासरसेन शोधितः ।

आरण्यकैरुत्पलकैरु पाचितः

करोति तारं त्रिपुटेन काञ्चनम् ॥ २ ॥

गन्धकशुद्धिः ।

## HINDU CHEMISTRY

किमत्र चित्रं रसको रसेन

\* \* \* \*

क्रमेण कृत्वाऽम्बुधरेण रक्षितः

करोति शुभं त्रिपुटेन काञ्चनम् ॥ ३ ॥ \*

रसकशोधनम् ।

किमत्र चित्रं दरदः सुभावितः

पथेन† मेघा बहुशोऽश्लवर्गेः ।

सितं सुवर्णं बहुघर्भभावितां

करोति साक्षादरकुलमप्रभम् ॥ ४ ॥

दरदशुद्धिः ।

कुलत्यकोद्भवकाये नरमूत्रेण पाचयेत् ।

वेतसाद्यश्लवर्गेण दत्त्वा क्षारं पुटत्रयम् ॥ ५ ॥

किमत्र चित्रं कदलीरसेन

सुपाचितं सूरणकन्दसंस्थम् ।

\* Agrees nearly with Rasārṇava ; cf. Vol. I, Sans. Texts, p. 13.

† पयसा is the correct form.

## HINDU CHEMISTRY

पुटेन दन्धं वसुधैविमले ।

पुटेन दन्धं वसुधैविमले ॥ ६ ॥

मासिकशोधनम् ।

द्विगुणा विमला पथ्य । रक्षातोयेन संयुता ।

लवणैर्वर्क\*दुग्धेन ताम्रपत्राणि लेपयेत् ॥ ८ ॥

अग्नौ सन्तप्य निर्गुणैरससिक्तानि सप्तधा ।

मासान् वसुरसेनैव शुक्लशुद्धिर्भविष्यति ॥ १० ॥

परतः सर्व्वलोहशोधनम् ।

अम्लवेतसधान्यान्लमेपीतोयेन शुध्यति ॥ ११ ॥

विमलशुद्धिः ।

चपलाद्या धातवः सर्व्वे जम्बीररसभाविताः ।

शोधितास्त्रिणिं पञ्चमृत्तिकाभस्मलावणैः ।

संयुताः संशोधयन्ति पुटपाकेन काञ्चनम् ॥ १२ ॥

हेमशोधनम् ।

नागेन चारराजेन आपितं शुद्धिमृच्छति† ।

\* The text reads वक्त्र, which is incorrect.

† This verse also occurs in Rasārṇava.

तारं त्रिवारनिक्षिप्तं पिशाचोत्तैलमग्गम् ॥१३॥

तारशुद्धिः ।

अहो नु चित्रं पृथिवीभवेन

क्षारेण मेघोपयसा घृतेन ।

तैलेन शुद्धं दुग्धोत्पाद्यं

भवेच्च शुद्धं शशिशृङ्गसन्निभम् ॥१४॥

मोक्षमारोटपालाश-क्षारगोमूत्रभावितम् ।

वज्रक-शिलाकल्का-फल-मूलसमान्वितम् ॥१५॥

तत्काष्ठां कण्टकं साक्षाच्चूर्णं वैक्रान्तसम्भवम् ।

सारधेन\* समायुक्तं मेघशृङ्गीद्रवान्वितम् ॥१६॥

पिण्डितं कम्बूप्लास्थं धामितश्च हठाम्बिना ।

तत्रैव पतते सत्त्वं वैक्रान्तस्य न संशयः ॥१७॥

वैक्रान्तसत्त्वं ।

क्षौद्रं गन्धर्व्वतैलं सघृतमभिन्नं

गो रसं मूत्रकक्ष

\* These couplets also occur in R. R. S., with this difference that in the latter नवसार has been substituted for सारधे.

भूयो वत्तालेतैलं कदालेरसः तं  
भावितं कान्तितप्तम् ।

मूषां तत्तालेतैलं कदालेरसः  
प्रक्षिपेन्मात्रेणै-

सत्त्वं नागेन्द्रतुल्यं पतति च सहसा  
सूर्यवैश्वानराभम् ॥ २५ ॥ \*

महावृक्षार्कक्षीराभ्यां स्त्रीस्तन्येन सुभावितम् ।  
रूपायामात्रे वर्णायां द्रवेस्ताप्यं न संशयः ॥ २६ ॥  
कङ्कुष्ठटङ्गुलाभ्याञ्च ताप्यं स्त्रीस्तन्यमर्हितम् ।  
पश्चात्सत्त्वं निपतति सत्त्वं मूषा तु अग्निवत् ॥ २७ ॥  
काञ्चिकं बहुशस्त्रिणं ताप्यचूर्णं कटुत्रिकम् ।  
कृत्वाम्बुमधुभ्यां पक्वं वज्रपायसभावितम् ॥ २८ ॥  
गृहधूमं घृतं क्षौद्रं संयुतं पुनरेव च ।  
धामितं रूपायामात्रे शशिशुल्बनिभं भवेत् ॥ २९ ॥  
कदलीरसशतभावितं घृतमध्वेरुतैलपाण्डुरम् ।  
ताप्यं मुञ्चति सत्त्वं रसकश्चैव त्रिसङ्गतम् ॥ ३० ॥

मात्रेणैकसत्त्वातनविधिः ।

चारस्यैव धान्यान् रसकं भावितं बहु ।

जर्णा लाक्षा तथा पथ्या भूलता धूमसंयुतम् ॥ ३१ ॥

मूकमूषागतं धातं टङ्कणेन समन्वितम् ।

सत्त्वं कुटिलसङ्काशं पतते नात्र संशयः ॥ ३२ ॥ \*

रसकसत्त्वम् ।

विमलं शिपुतोयेन काक्षीकासीसटङ्कणैः ।

वज्रकन्दसमायुक्तं भावितं कदलीरसैः ॥ ३५ ॥

माक्षीकचारसंयुक्तं धामितं मूकमूषके ।

सत्त्वं चन्द्रार्कसङ्काशं पतते नात्र संशयः ॥ ३६ ॥ †

विमलसंयुतम् ।

दरदं पातनायन्ने पातितञ्च जलाशये ।

सत्त्वं रत्नकसङ्काशं जायते नात्र संशयः ॥ ३७ ॥

दरदसत्त्वम् ।

गन्धकश्च प्रभावेण सत्त्वभूयं स्वभावतः ।

\* Cf. Rasārṇava, Benares MS. V. 37—38.

† Cf. Sans. Texts, Vol. I. p. 12. R. R. S. Bk. ii.

## HINDU CHEMISTRY

ततः स्यातं महासत्त्वं रवेन्द्रस्य समं ततः ॥ ३८ ॥

अभक्तः ॥ सत्त्वपालनविधिः ।

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एक एव महाद्रावी पार्वतीनामसम्भवः ।

किं पुनस्त्रिभिः संयुक्तो वेतसान्नाम्नकाञ्चिकैः ॥ ५० ॥

रक्षाफलानि सप्ताहं वेतसान्नेन भावयेत् ।

पुटपाके ततस्त्रुणे द्रवते सलिलं यथा ।

कुरुते योगराजोयं रत्नानां द्रावणे परम् ॥ ५१ ॥

अभक्तः ॥ रक्षुत्पातविधिः ।

तालैर्न वक्त्रं दरदेन तीक्ष्णं

नागेन हेमं शिलाया च नागम् ।

गन्धाश्मना चैव निहन्ति शुल्बं

तारञ्च माञ्चीकरसेन हन्यात् ॥ ५२ ॥

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शुल्बम् अजाक्षीरसुगन्धकीन

तारं कुहीक्षीरसुमाञ्चिकेण ।

यद्यस्य धातोर्विहितञ्च युक्तं

निहत्यधातं कथितञ्च तीक्ष्णैः ॥ ५४ ॥

मृतानि लोहानि रसीभवन्ति

रसेन युक्तधामयनाशनानि ।

अभ्यासयुक्ता पलितादिनाशं

कुर्वन्ति तेषाञ्च ज ॥८८॥ ॥ ५५ ॥

इति नागार्जुनविरचिते रसरत्नाकरे वज्रमारण-

सत्त्वपातन-अभ्रकादिद्रुतिद्रावण-वज्रलोह-

मारणाधिकारो नाम द्वितीयः ।

अथातो रसबन्धाधिकारं व्याख्यास्यामः ।

जम्बीरजेन नवसारधनान्त्वर्गैः

क्षाराणि पञ्च लवणानि कटुत्रयञ्च ।

शिथूदकं सुरभिसूरणकन्द एभिस्-

संमर्दितो रसमृपसरतेष्टलोहान् ॥ १ ॥

चारणजारणविधिः ।

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प्रज्ञापारमिता निर्णायकसमं स्वप्ने प्रसादीकृतं

नाम्ना तीक्ष्णमुखं रसेन्द्रममलं नागार्जुनप्रोदितम् ॥४॥

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रसं हेमसमं मर्द्यं पोठि कागिरिगन्धकम् ।  
 द्विपदीरजनीरक्षां मर्दयेत् उन्मूलयेत्तम् ॥ ३० ॥  
 गन्धकं च गन्धमूषां निधापयेत् ।  
 तुषाणघुपुटं दत्त्वा यावद्भस्मत्वमागतः ॥ ३१ ॥  
 भक्षणात्साधकेन्द्रसु दिव्यदेहमवाप्नुयात् ॥ ३२ ॥

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गर्भयन्त्रं प्रवक्ष्यामि पीठिकाभस्मकारकम् ।  
 चतुरंगुलदीर्घेण विंशत्यङ्गुलं च चण्डुलाम् ॥ ६२ ॥  
 मूषां तु मृष्ययीं कृत्वा सुदृढां वर्तुलां बुधः ।  
 विंशभागन्तु लोहस्य भागमेकं तु गुग्गुलीः ॥ ६३ ॥  
 सुस्रक्ष्णं पेषयित्वा तु तीयं दत्त्वा पुनः पुनः ।  
 मूषालेपं दृढं बद्धा लोणाद्विमृत्तिका बुधः ॥ ६४ ॥  
 कर्षं तुषाग्निना भूमौ मृदुस्वेदेन स्वेदयेत् ॥ ६५ ॥\*  
 सूतकस्य पलं गृह्यं तुर्यांशं साक्तुकं विषम् ।  
 तत्समं गन्धकं शुष्कं चूर्णं कृत्वा विनिक्षिपेत् ॥ ८४ ॥  
 कृत्वा कज्जलिकामादौ पलं दत्त्वा च गन्धकम् ।  
 घृतपक्वञ्च तच्चूर्णं पचेदायसभाजने ॥ ८५ ॥

यावद्भवत्वमायाति तत्क्षणात् तं विनिश्चयेत् ।

पुटे वा कदलीपत्रे सिद्धं पर्यटिकारसम् ॥ ८६ ॥

द्वितीयपर्यटिकारसः ।

प्रणिपत्य सर्व्वबुद्धान्

(सद्बोधान्) सकलदोषनिर्मुक्तान् ।

वक्ष्ये सर्व्वहितार्थं

कक्षापुटं सर्व्वसिद्धिकरम् ॥

श्रीशैलपर्व्वतस्थायो सिद्धो नागार्जुनो महान् ।

सर्व्वसत्त्वोपकारी च सर्व्वभाग्यसमन्वितः ॥

प्रार्थितो ददते शीघ्रं यच्च पश्यति यादृशम् ।

दृष्ट्वा त्यागञ्च भोगञ्च सूतकस्य प्रसादतः ।

सर्व्वसत्त्वामयावेधौ स्वरसेन तथैव च ॥

तेषां मध्ये प्रधानञ्च रुद्धघोषः प्रचारकः ।

कृताञ्जलिपुटो भूत्वा नागार्जुनपुरः स्थितः ।

पृच्छते रसकर्मणि विद्यादानं ददस्व मे ॥

श्रीनागार्जुन उवाच—

साधु साधु न । प्राञ्जलपुटोऽहं भक्तवत्सलः ।

न । यत्किञ्च न सन्देहस्तत्त्वया परिपृच्छ्यताम् ॥

बलीपलितनाशश्च तथा कालस्य ध्वंसनम् ।

यथा लोहे तथा देहे क्षमते नात्र संशयः ॥

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सत्त्वानां भोजनार्थाय साधिता वटयक्षिणो ।

द्वादशानि च वर्षाणि महाक्षेशः कृतो मया ॥

तत्कालदृष्ट-व्याणां दिव्या वाणो मया श्रुता ।

षट्पञ्चदशैक पञ्चादृष्टा त्वं भव साम्प्रतम् ॥

श्रीवटयक्षिण्युवाच—

साधु साधु महासिद्ध \* \* \*

किञ्चिन्नार्थय मे सिद्ध तत्सर्व्वं प्रददाम्यहम् ॥

श्रीनागार्जुन उवाच—

यदि तुष्टासि मे देवि सर्व्वदा भक्तियत्सले ।

दुर्लभं त्रिषु लोकेषु रसबन्धं ददस्व मे ॥

शालेवा न उवाच—

सुवर्णरत्नभाण्डारं कुमारी मदसुन्दरी ।

निवेदितो मयास्मा मे आदेशो देवि दीयताम् ॥

साधु साधु म । प्राञ्ज ममाभिषेकपालक ।

साधयामि न सन्देहो बुधस्तत्त्वेन साधकम् ॥

पुनरन्यं प्रवक्ष्यामि माण्डव्येन यथा कृतम् ।

रसोपरसयोगेन सिद्धं सूतं सुसाधितम् ॥

विद्वशुत्वायनं नागं यथार्थकाञ्चनं कृतम् ।

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शास्त्रं वाग्नेष्ठमाण्डव्यं गुरुपार्श्वे यथा श्रुतम् ।

तदहं सम्प्रवक्ष्यामि साधनञ्च यथाविधि ॥

सहायशोभनाः प्राज्ञा निरालम्भा दृढव्रताः ।

कुलीनाः पापहीनाश्च साधयन्ति जितेन्द्रियाः ॥

कोष्ठिकाः क्षालिताः गोमयं सारमिन्धनम् ।

धमनं लोहपत्राणि औषधं काञ्चिकं विडम् ॥

कन्दराणि विचित्राणि \* \* \*

सर्ज्यमेलयनं कृत्वा ततः कर्म समारभेत् ॥

रत्नघोष उवाच—

साधयित्वा प्रयत्नेन कोटिवेधी महारसः ।

शरीरेण विनैतेन सर्ज्यं भवति निष्फलम् ॥

नागार्जुन उवाच—

पथ्यादि न सन्देहः साक्षाच्छेन यथा कृतम् ॥

पार्श्वं च घनं च चापत्वं गुरुतेजसः ।

यस्यैतानि न दृश्यन्ते तं विद्यागुरुसूतकम् ॥

नानावर्णं भवेत्सूतं विहाय घनचापलम् ।

लक्षणं दृश्यते यस्य मूर्च्छितं तं वदन्ति हि ॥

गुरुत्वमरुणत्वं वा तेजो भास्करसन्निभम् ।

अग्निमध्ये यदा तिष्ठेत् खोटबन्धस्य लक्षणम् ॥ \*

अथातो रसेन्द्रमङ्गलानि यन्त्रविधिः ।

शिलायन्त्रं, पाषाणयन्त्रं, भूधरयन्त्रं, वंशयन्त्रं,  
नलिकायन्त्रं, गजदन्तयन्त्रं, दोलायन्त्रं, अधःपातन-  
यन्त्रं, भुवःपातनयन्त्रं, पातनयन्त्रं, नियामकयन्त्रं,  
गमन(?)यन्त्रं, तुलायन्त्रं, कच्छपयन्त्रं, चाकीयन्त्रं,  
बालुकायन्त्रं, अग्निसोमयन्त्रं, गन्धकत्राहिकयन्त्रं,  
मूषायन्त्रं, हण्डिकायन्त्रं, कम(?)भाजनयन्त्रं, घोणा-  
यन्त्रं, गुडाम्रकयन्त्रं, नारायणयन्त्रं, जालिकायन्त्रं,  
चारणयन्त्रम् ।

अथ प्रवक्ष्ये सुरूपदेशान्

यः पाटलाख्यस्य रसस्य वृद्धः ।

यस्य प्रभावात् ज्ञयमेहलक्ष-  
 ज्वरादि विषादभयानेयहः स्यात् ॥  
 निश्चिप्य खल्ले त्रिपुरान्तकस्य  
 वीजं द्विशुद्धार्धपलप्रमाणम् ।  
 क्वाथेन तस्य त्रिपुरोद्भवेन  
 सन्मर्दयेत्तु चिनिनि यावत् ॥  
 कन्धारसेन चिदिनं ततश्च  
 सप्तार्चिषा चाद्यं दिनत्रयञ्च ।  
 चूर्णेस्त्रिकाया रजनीरजेन \*  
 सन्मर्दितं तम् उषतोयधीतम् ॥  
 त्रीणि प्रमाणान्यथ सप्तमञ्च  
 सम्पातयेत् पातनयन्त्रयोगात् ।  
 सम्पातितो निर्मलतामुपैति  
 सर्वप्रयोज्योपि हितं प्रशस्तम् ॥  
 पलं समादाय रसस्य तस्य  
 शुक्लस्य शुद्धस्य च कर्षमेकम् ।

\* The text seems to be incorrect.

तत्त्व।८पिष्टौ विधिवर्त्तयोश्च  
 गन्धाश्मचूर्णं द्विगुणश्च देयम् ॥  
 घृतप्रयोगेण विपाच्य पञ्चान्-  
 निक्षिप्य खल्ले परिमर्दितश्च ।  
 निष्कश्च मात्रां त्वमृतस्य दत्त्वा  
 गुञ्जाप्रमाणा गुटिका च कार्य्या ॥  
 श्रीलोकादिस्य विभोः प्रसादात्  
 ज्ञातं मया पोटलिकाविधानम् ॥

\* \* \* \* \*

इति रसेन्द्रमङ्गलं समाप्तम् ।

—

# Extracts from RASAHRIDAYA.

भगवद्गोविन्दपादविरचितात्  
रसहृदयादुद्धृताः श्लोकाः ।

A = MS. from Nepal.

B = MS. from India Office Library, with a commentary, named "Bāḷānvayabodhikā."

C = MS. from Benares.

द्वितीयपटलादुद्धृताः श्लोकाः ।

[टीका—मूर्च्छितरसस्य उत्थापनसंस्कारमाह—]

अमुना विरेचनेन हि सुविशुद्धो नागवक्त्रपरिमुक्तः ।

सूतः<sup>१</sup> पातनयन्त्रे समुत्थितः<sup>२</sup> काञ्चिके काथात्<sup>३</sup> ॥

[टीका—अथ मूर्च्छितरसस्य पञ्चमोद्दिष्टपातनसंस्कारं  
अष्टयन्त्रा—]

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(1) A reads पात्र, which makes the sentence incomplete and the metre defective.

(2) A reads सुविशुद्धं, which is a tautology as well as a grammatical error.

(3) काञ्चिकेन काथात् is the variant in B. This is a defective metre.

कृत्वा तु शुल्बपिष्टीं<sup>1</sup> निपात्यते नागवङ्गशङ्कातः<sup>2</sup> ।  
 तस्मिन् दोषान् मुक्ता<sup>3</sup> निपतति शुद्धस्तथा सूतः<sup>4</sup> ॥  
 अष्टाङ्गुलविस्तारं<sup>5</sup> दैर्घ्यं<sup>6</sup> दशाङ्गुलं त्वधीभाण्डम् ।  
 कण्ठादधः समुच्छ्रितचतुरङ्गुलकज्जलाधारम्<sup>7</sup> ॥  
 अन्तःप्रविष्टतलभाण्डं<sup>8</sup> वनजलमग्नानेजमुखग्रान्ता<sup>9</sup> ।  
 उपरिष्ठाक्षिपिटपटी<sup>10</sup> देयोदरषोडशाङ्गुलविशाला ॥

(1) A reads सुल्बपिष्टम्.

(2) निपात्यते नागवङ्ग सदोष is the reading in A, which is incorrect as well as defective metre.

(3) A reads मुक्ते दोषान्मुक्ता.

(4) A reads शुद्ध, which is a tautology as well as a grammatical error.

(5) B reads अष्टाङ्गुलस्य विस्तीर्णं, which destroys the metre.

(6) B reads दैर्घ्यं तु, wherein तु is redundant.

(7) B reads समं तच्चतुरङ्गुलं कृतज्जलाधारा, which mars the metre.

(8) A reads अन्तःप्रविष्टतलभाण्डं, which is a defective metre.

(9) B reads ग्रान्तः, which is grammatically incorrect.

(10) A has उपरिष्ठाक्षिपुटपटित, which is senseless.

तस्मिन् धोर्द्धभाण्डे<sup>1</sup> निपातितः सकलदोषनिर्मुक्तः<sup>2</sup> ।  
 सुतरां भवति रसेन्द्रो जोर्णग्रासोऽपि पात्योऽसौ<sup>3</sup> ॥  
 कृत्वाय<sup>4</sup> नष्टपिष्टं त्रिफलाशिखिशिथुराजिकापटुभिः  
 संलेप्य चोर्द्धभाण्डं दीप्तैरुपलैरधः पात्यः<sup>5</sup> ॥  
 अथवा दीपकायन्त्रे<sup>6</sup> निपातितः सकलदोषनिर्मुक्तः ॥  
 कच्छपयन्त्रान्तर्गत<sup>7</sup> मृन्मयपीठस्थदीपिकासंस्थः ।  
 यस्मिन्निपतति सूतः प्रोक्तं<sup>8</sup> तद्दीपिकायन्त्रम् ॥

(1) A reads तस्मिन् धोर्द्धभाण्डे, which is incorrect.

(2) निपातितसकलनिर्मुक्तः, an incomplete variant in A.

(3) A has an incorrect reading—ग्रासजोर्णपपात्यासौ.

(4) This verse and the next two are not found in B.

(5) A reads रपवैरधःप्राता, which has no sense.

(6) A has दीपिकायन्त्रे.

(7) A reads कच्छपयन्त्रे अन्तर्गत, which is grammatically incorrect.

(S) The word तत् is not found in A, thus making the metre defective.

सप्तमः पटलः ।

[टीका—अथ विडविधानमारभ्यते—]

ग्रासं न मुञ्चति न वाञ्छति तच्च भूयः

काञ्चिद्गुणान्<sup>1</sup> भजति<sup>2</sup> नित्यमनुक्तमात्रात्<sup>3</sup> ।

यज्जीर्यते प्रचुरकेवलवह्नियोगात्

तस्माद्विडैर्मुनिविडैः सह<sup>4</sup> जारणा स्यात् ॥

[टीका—विडविधानमाह—]

सौवर्चलकटुकत्रयकाङ्क्षी<sup>5</sup> काशीसगन्धकैश्च विडैः ।

शिग्रो रसशतभाव्यैस्ताम्रदलान्यपि हि जारयति<sup>6</sup> ॥

[टीका—विडान्तरमाह—]

(1) A reads काचोद्गुणान्, which is incorrect.

(2) B reads व्रजति.

(3) अनुक्तविमुक्तमात्रात् is the variant in A.

(4) A reads मुनियतैरिमु, which seems to be incorrect.

मुनिविडैः means by seven विडs, mentioned below.

(5) A reads काञ्जि, which is incorrect.

(6) A has शिग्रुरसशतभावितम् । तस्य दनास्यपि हि जारयति, which is incorrect as well as defective in metre.

सर्व्वाङ्गदग्धमूलकप्रतिगलितं सुरभिर्मूत्रेण<sup>1</sup> ।

शतभायं बलिवसया<sup>2</sup> तत्क्षणतो जायते हेम ॥

[टीका—अथ चारुचङ्गुलीषधीराह—]

तत्त्वोपलब्धति<sup>3</sup> निपुलकनकसुरदालिवा<sup>4</sup> कौरण्डः ।

वर्षाभूषमोक्षक<sup>5</sup> सहिताः चारा यथा लाभम् ॥

[टीका—चारविधानमाह—]

आनीय चारुचान् सुसुमफलाशेफा-

त्वक्पलाशैरुपेतान्<sup>5</sup>

कृत्वातः खण्डसप्तान्<sup>6</sup> विपुलतरशिला-

पिष्टपाचतिष्कान्<sup>7</sup> ।

(1) सर्व्वाङ्गं दग्धमूलकं रसप्रतिप्रतिगलितसुरभिर्मूत्रेण, a variant in A, which has no metre at all.

(2) A reads शतभावितरसवश्या, which has no sense.

(3) तिष्ठ is not found in B.

(4) A reads माक्षौक, which seems to be incorrect.

(5) सुसुमफलाशेफाशेफैरुपेतान् is an incorrect text in A.

(6) A reads कृत्वा तत्खण्डसप्तान्, which is incorrect.

(7) A has विपुलतरशिलापुष्टगामातिष्कान्.

दग्धं काष्ठैः। तिलानां करिसुरभिहया-

शोभिरास्त्राव्य वस्त्रैः<sup>1</sup>

भस्म त्यक्त्वा जलं तत्<sup>2</sup> मृदुशिशिनि पचेत्

हंसपाकेन भूयः<sup>3</sup> ॥

[टीका—चारजलपाकलक्षणमा —]

तच्छुष्यमाणं हि सवास्यगुदगुदा-

यदा विधत्ते<sup>4</sup> क्षणभङ्गुरान् बह्वन् ।

तदा क्षिपेत् चूषण<sup>5</sup> हिङ्गुगन्धकं

चारयं सप्तवर्णानि भूखगम्<sup>6</sup> ॥

(1) A reads करिसुरभिहयोद्गाजकानां च मूत्रैः.

(2) A reads तं, which is incorrect.

(3) A reads यावत्.

(4) A reads erroneously यथा वदते.

(5) A reads क्षिपेन्मूत्रं. B reads क्षिपेन्मूत्रं. Both the readings are incorrect.

(6) A has चारयितव्यं पटुलवर्णं भूमिखगं, which mars the metre.

द्रव्याणि संमिश्र्य निवृत्य भूतले  
व्यवस्थितान्यस्त्रिकटोरिकापुटे<sup>1</sup> ।  
संस्थापयेत् सप्तदिनानि धान्यगं  
ततः प्रयोज्यं रसजारणादिकम् ॥

[टीका—जारणायां चारविधानमाह—]

ज-बीरवोजपूरक<sup>2</sup> चाङ्गेरोवेतसान्नसंयोगात् ।  
चारा भवन्ति नितरां गर्भद्रुतिजारणे शक्ताः<sup>3</sup> ॥

[टीका—रसे विड्याजनमा—]

विडमधरोत्तरमादौ दत्त्वा सूतस्य चाष्टमांशेन<sup>4</sup> ।  
कुर्यात्जारणमेवं क्रमक्रमाद्वैद्येदग्निम्<sup>5</sup> ॥

(1) A reads व्यवस्थितान् सस्त्रिकटोरिकासुवे । B reads व्यवस्थितसस्त्रिकटोरिकापुटे ।

(2) A reads बीजपूरकं, which is incorrect. The word बीजपूर is not found in B.

(3) गर्भद्रुतिजारणा शक्ता is an incorrect variant in A.

(4) A has दत्त्वा सूतं चाष्टमांशेन, which is not correct as it destroys the metre as well as the sense.

(5) A reads वैद्येदग्निः, which is grammatically incorrect.

अष्टमः पटलः ।

[टीका—अथ रसरागोऽभिधास्यते—

अभ्रकजीर्णस्य छायाविशेषमाह—]

जीर्णाभ्रको<sup>१</sup> रसेन्द्रो

दर्शयति<sup>२</sup> घनानुकम्पिनीं छायाम्<sup>३</sup> ।

लक्ष्णां रक्तां पीतां

सितां<sup>४</sup> तथा सङ्करं मिश्राम्<sup>५</sup> ॥

(1) A reads जीर्णाभ्रक, which mars the metre.

(2) A reads दुर्दृश्यति, which is incorrect.

(3) घनानुकम्पिनी छाया is the variant in A. घनानुक्तपर्ण-  
छाया is the variant in B. Both the readings seem to be  
incorrect.

(4) लक्ष रक्ता पीतां शितां is the reading in A, which is  
incorrect.

(5) A reads ददा संकराभिन्नाः, which is incorrect.

[टीका—अभ्रकयोगाद्वर्णविशेषमाह—]

अभ्रककेण बलवत्<sup>1</sup> सितरागैर्युज्यते<sup>2</sup> रसेन्द्रसु ।

श्वेतै रक्तैः पीतैः वज्रैः खलु वर्णतो ज्ञेयः<sup>3</sup> ॥

[टीका—अथ रञ्जितरसप्रशंसामाह—]

अथ निजमेव हि वर्णं<sup>4</sup>

न जहाति यदा स रज्यते<sup>5</sup> रागैः ।

क्रमशो हि भक्ष्यमाणी<sup>6</sup>

निर्निक्षो<sup>7</sup> रञ्जनं कुर्वते ॥

(1) अताभ्रकेन बलवान् is the variant in A, which is incorrect.

(2) A reads सितरागैः युज्यते.

(3) A has नविद्युतो ज्ञेयं, which has no clear sense. B has वज्रिवर्णतो ज्ञेयः, which mars the metre.

(4) B reads अथ निजकर्णवर्णं, which is not correct.

(5) A reads यदा रसजीयेते, which is grammatically incorrect.

(6) A reads भक्ष्यमाणा, which is incorrect. B reads क्रमशो वक्ष्यमाणी, which is also incorrect.

(7) A reads नारक्षो.

[टीका—चन्द्रसत्त्वादीनां योगे रवे व्यवस्थामाह—]  
 बलमास्तेभ्यकसत्त्वे जा० रागाः प्रतिष्ठितास्तीक्ष्णे<sup>1</sup> ।  
 बन्धश्च सारलोहे<sup>2</sup> सारणमथ<sup>3</sup> नागवज्राभ्याम्<sup>4</sup> ॥

[टीका—सर्व्वकरणं तोष्यमा—]  
 क्रामति तोष्येन रसः तोष्येन<sup>5</sup> जीर्यते चचाद्वासः<sup>6</sup> ।  
 हेम्नो योनिस्तीक्ष्ण<sup>7</sup> रागान् गृह्णाति तोष्येन ॥

[टीका—तीक्ष्णहिङ्गुलयोगेन गुणाधिक्यमाह—]  
 तदपि च दरदेन हतं हत्वा माचीकेण रविसहितम्<sup>8</sup> ।  
 वासितमपि वासनया घनवद्यार्य्यञ्च आर्य्यञ्च ॥

- (1) A reads erroneously प्रतिष्ठिता तीक्ष्णा.
- (2) A reads सारणलहेः, which is incorrect.
- (3) A reads क्रामणमथ.
- (4) B reads नागवज्रमतः.
- (5) A reads तीक्ष्णे च.
- (6) A reads चासे, which is incorrect.
- (7) A reads ज्योतिस्तीक्ष्णी, which has a defective metre.
- (8) B has omitted हत्वा माचीकेण रवि.

[टीका—तीक्ष्णवदेतानाह—]

कान्तं वा तीक्ष्णं वा काङ्क्षीं वा वज्रसस्यकं वापि<sup>1</sup> ।

एकतमं सर्व्वं वा रसरजने सङ्करोऽभीष्टः<sup>2</sup> ॥

[टीका—स्वे स्वे विकारे वक्ष्यमाणमाह—]

कुटिले<sup>3</sup> बलमप्यधिकं रागस्तीक्ष्णे तु पन्नगे स्नेहः<sup>4</sup> ।

रागस्नेहबलानि तु कमले शंसन्ति धातुविदः<sup>5</sup> ॥

सर्व्वैरेभिर्लोहेर्माक्षिकसहितैर्मृतिस्तथा गर्भे ।

चिङ्गयोगिन तु जीर्णे रसराजो विशति लोहेषु ॥<sup>6</sup>

[टीका—रसबन्धानां मारणे विधानमाह—]

तालक<sup>7</sup>दरदशिलाभिः स्नेहधाराक्षलवणसत्ताभिः ।

(1) काङ्क्षीं वा वज्रसस्यकादीनां, a variant in B.

(2) रसेपि हि रसायने बिद्यात्, a variant in A.

(3) This is not found in B.

(4) A reads erroneously पन्नगस्नेह.

(5) A reads धातुविधं, which is incorrect.

(6) This sloka is not found in B.

(7) A reads तारक.



एकेन वापितनृतं<sup>1</sup>

कमलं रञ्जयति रसराजम् ॥

[टीका—रागाधिकारि-गन्धकादीनाह—]

वाङ्मो गन्धकरागो<sup>2</sup> विलुलितरागे<sup>3</sup> मनःशिलाताले ।  
माक्षीक<sup>4</sup>सत्वरसकौ द्वावेतौ<sup>5</sup> रञ्जने शस्तौ ॥

[टीका—प्रधानयोः तान्त्र वर्परयोः छत्यमा—]

क्रमवृद्धैः रविरेकैः<sup>6</sup> संशुद्धो मूकमूषिकाभातः<sup>7</sup> ।

(1) A reads वापितनृतं, which seems to be incorrect.

(2) A reads गन्धकराग, which is incorrect.

(3) A reads शितरागो. B reads विलुलितरागेण. Both the readings are grammatically incorrect.

(4) B reads माक्षीक, which mars the metre.

(5) B reads द्वावे द्वि, which seems to be incorrect.

(6) A reads क्रमवृद्धै रविरेकैः. B reads क्रमवृद्धौ रविरसकौ.

We have adopted the above reading after collating the texts.

(7) मूषिकामूषिकाभातः, a variant in A, which mars the metre. मूकमूषिकाभाती, a variant in B.

त्रिगुणं जीर्णो जीर्णो<sup>1</sup> हेमाभो जायते<sup>2</sup> सूतः ॥

[टोका—अभ्रकयोगमाह—]

अथ<sup>3</sup> कृष्णाभ्रकचूर्णं पुटितं रक्तं भवेत्तथा<sup>4</sup> शकलम् ।

त्रिगुणं जीर्णो जीर्णो<sup>5</sup> हेमदुतिसंनिभः सूतः<sup>6</sup> ॥

[टोका—स्वर्णमारणमाह—]

त्रिगुणेन माक्षिकेण तु कनकं च सूतं रसतालयुतम्<sup>7</sup> ।

पटुसहितं तत् पक्वं हण्डिकया यावदिन्द्रगोपनिभम् ॥

(1) A reads जीर्णं जीर्णं. B reads जीर्णो जीर्णो.

(2) A reads द्रुतिहेमनिभो भवेत्, (द्रुति=द्रुत.) B reads हेमवर्णाभो जायते, which mars the metre.

(3) A reads अथवा, which destroys the metre.

(4) A omits तथा.

(5) A reads जीर्णं जीर्णं, which seems to be incorrect. B reads जीर्णो जीर्णो.

(6) हेमद्रुति(?)संनिभो भवेत् सूतः, a variant in A.

(7) कनकञ्च रसतालयुतं, a variant in A, which is a defective metre. The reading of B, which we have adopted, is also a defective metre. The word चित् or व्यान् should be added after the word युतम्.

[टोका—एतद्भस्मजोर्णसूतस्य लक्षणमाह—]

तच्चूर्णं सूतवरे त्रिगुणं जीर्णं हि<sup>1</sup> जीर्णं तु ।

द्रुतहेमनिभः सूतो<sup>2</sup> रज्यति लोहानि सर्व्वाणि<sup>3</sup> ॥

[टोका—सर्व्वेषां धातूनां रसानामुत्तरोत्तरविशेषत्व-  
माह—]

पचादष्टगुणं सत्त्वं सत्त्वादष्टगुणं धृतिः ।

धृतेरष्टगुणं बीजं तस्माद्बीजं तु जारयेत् ॥<sup>4</sup>

(1) A reads जीर्णं . B reads क्षीर्णं हि.

(2) द्रुतहेमनिभसूतो, a variant in A, which seems to be incorrect.

(3) A has अरति लोहानि सत्त्वानि. B has रज्यति लोहानि सर्व्वाणि. Both the readings have defective metre.

(4) This verse is found in A after the verse तारक-  
दण्डशिलाभिः &c. (vide ante pp. 28—29) and runs thus :—

पचादष्टगुणं दत्त्वा सत्त्वादष्टगुणं धृतिः ।

धृतेरष्टगुणं बीजं तस्माद्बीजं तु जारयेत् ॥

नवमः पटलः ।

[टीका—बीजप्रशंसनमाह—]

इति रक्तोऽपि रसेन्द्री बीजेन विना न कञ्चन भवति ।

द्विविधं तत् पीतसितं<sup>1</sup> नियुज्यते सिद्धये च रसम्<sup>2</sup> ॥

[टीका—रसापरसत्वात्<sup>3</sup> बहुविधत्वात् शोधन-  
माह—]

तस्य विशुद्धिर्बहुधा<sup>3</sup> गगनरसीपरसत्वाह<sup>3</sup> ॥

द्विविधं बीजं तैरपि नाशुद्धैः शुध्यते कदाचिदपि<sup>4</sup> ॥

[टीका—अत्र बीजप्रभावमाह—]

यः पुनरैतैः कुरुते कर्माशुद्धेर्भवेद्भस्मस्य ।

(1) B reads पीतं सितं, which destroys the metre.

(2) नियुज्ये सिद्धये च रसः, an incorrect variant in A. नियुज्यते सिद्धये च तत्, a variant in B. Both texts are collated in our adopted reading.

(3) रसति शुद्धिर्बहुधा, a variant in A, wherein the first term seems to be incorrect.

(4) B reads नैतत् instead of कदाचिदपि. This is incorrect ; since it contains two negatives.

अव्यापकः पतङ्गो<sup>1</sup> न रसे न रसायने योग्यः<sup>2</sup> ॥

[टीका—रससंग्रहाना —]

वैक्रान्तकान्त<sup>3</sup>सख्यकमाशिक<sup>4</sup>विमलाद्रिदरद-  
रसकाश<sup>5</sup> ।

अष्टौ रसास्तथैषां सत्त्वानि<sup>6</sup> रसायनानि स्युः ॥

[टीका—उपरससंग्रहानाह—]

गन्धकगैरिकसुशिला<sup>7</sup>चित्तिखेचरमञ्जनच-  
कहुष्ठम् ।

उपरससंग्रमिदं<sup>8</sup>स्यात् त्रिखिग्रशिनी सारलोहास्थी ॥

(1) अव्यापकपतंगि, a variant in A, which is incorrect.

(2) A reads योग्ये. B reads रसायनयने योग्यः. Both the readings are incorrect.

(3) A omits कान्त.

(4) A reads माशिक, which mars the metre.

(5) A reads दलदरसकैश.

(6) A reads अष्टादि, which is not accurate.

(7) B reads त्रिलालक, which destroys the metre.

(8) B reads संग्रहमिदं, which mars the metre.

[टीका—पूतिसंज्ञके आह—]

ताम्बारतौखकान्ताभ्रवज्जलोहानि<sup>1</sup> नागवङ्गौ च<sup>2</sup> ।

कथितौ च पूतिसंज्ञौ<sup>3</sup> तेषां संशोधनं कार्यम् ॥

[टीका—लवणक्षारसंज्ञे आह—]

सोवर्णसैत्थिकं चूलिकसारद्रोमकविडानि ।

षड्लवणक्षारानि तु सर्जयिवटङ्गणाः क्षाराः ॥<sup>4</sup>

[टीका—शोधकत्वकगणमाह—]

सूर्यावर्तः<sup>5</sup> कदली कन्या<sup>6</sup> कोशातकी च सुरदाली ।

शीघ्र<sup>7</sup> वज्रकन्दो नीरकणा काचमाची च ॥

आसामेकरसेन तु लवणक्षारान्तरभाविता बहुशः ।

शुद्ध्यन्ति रसोपरसा धाता मुच्यन्ति सत्त्वानि ॥<sup>8</sup>

(1) B reads सत्त्वलोहानि.

(2) B reads वङ्गनागौ च.

(3) B reads कथितौ कभूतसंज्ञौ, which is incorrect.

(4) This verse is not found in A.

(5) A reads सूर्यावर्तक.

(6) B reads कन्या.

(7) A reads शीघ्र.

(8) This verse is found in A only.

[टीका—शोधकः। वकायाः। यान्। स्वविधान-  
माह—]

खिन्नं सञ्चारणैः<sup>1</sup> भातं चेज्जान्तकं हठा वात<sup>2</sup> ।  
तद्वदुतमात्रं<sup>3</sup> शुध्यति कान्तं यथारक्तभावनया ॥

[टीका—तथाह—]

सख्यकमपि रक्तगणैः<sup>4</sup> सुभाषितं खेहरागसं तम्<sup>5</sup> ।  
शुध्यति वारैः<sup>6</sup> सप्तभिरतः परं शुष्यते कार्थ्ये<sup>7</sup> ॥

[टीका—तथाह—]

वारैः खेहरादी पद्यादाब्जेन<sup>8</sup> भाषितं विमलम् ।

(1) A reads सञ्चारणैः.

(2) A reads हठाद्वति, which is incorrect.

(3) A reads तद्वदुतमात्रं, which is incorrect.

(4) B reads रसुगणैः, which seems to be incorrect.

(5) भावनयः खेहरागसंसिद्धः, a variant in A.

(6) A reads वारैः.

(7) सप्तभिरतः परं योजयेत् कार्थ्ये, a variant in A, which  
mars the metre. B reads सप्तभिरभितः परं, wherein अभितः  
is incorrect as well as a defective metre.

(8) B reads पद्यात् सञ्जेन.

सुहृन्ति तन्मात्रं दत्तं ददं नाशेनानि ॥

[टीका—तन्मात्रं दत्तं ददं नाशेनानि—]

तनुरविपचं सितं<sup>2</sup> सवचपा रान्तरनि<sup>3</sup> कभीदे<sup>3</sup> ।

जातं निर्नु<sup>4</sup> रान्तरनि बहुसो वह द्रवत्वच<sup>4</sup> ॥

[टीका—सोहृन्ति दत्तं ददं नाशेनानि—]

सुहृन्ति नागो वङ्गो घोषो रविचा च वार निरसंख्यैः<sup>5</sup> ।

निर्गुण्डीरसवेकै<sup>6</sup> दान्तरजः प्रवापेच ॥

[टीका—तन्मात्रं—]

(1) ददमात्रिकमप्येवं तथा सुहृन्ति, a variant in A, wherein the last two words are superfluous and incorrect.

(2) B reads तनुरपि पचसितं, which has no sense.

(3) A reads सुहृन्ति. B reads सुहृन्ति. Both the readings destroy the metre.

(4) A reads बहुसो वङ्गद्रव्यं. B reads बहुसो द्रवत्वच. Both the readings are defective.

(5) घोषो रविरोधनपि च मुनिसंख्यैः, a variant in A. B reads रविचा च वारमुनिभिः. Both the readings are incorrect.

(6) B reads सितं, which is not correct.

रक्तगणगालेतप जलभावितपुटितं<sup>१</sup> च रज्यते<sup>१</sup> तोष्यम् ।

शुद्धति कदलीज्वास्त्ररसभावितं पुटितं<sup>२</sup> त्रिभिर्वारैः ॥

[टीका—मारणमा—]

सर्व्वः शुद्धति लोहो रज्यति<sup>३</sup> सुरगोपसन्निभो वापात् ।

माद्विकसस्त्वे भृङ्गं<sup>४</sup> शुल्वं वा गन्धकीन हृतम्<sup>५</sup> ॥

एकादशः पटलः ।

छागास्त्रिभस्मनिर्भितमूषां क्षत्वेवामलकाकारां ।

दसयोगे घनरन्ध्रां टंकणविषं च क्षतलेपां ॥

(1) A reads रज्यते, which is incorrect.

(2) शुद्धति कदलीज्वास्त्ररसभावितं पुटितं, an incorrect variant in B.

(3) A and B read रज्यति, which is grammatically incorrect.

(4) A reads सहस्रं. B reads दरद्दिन भं. Both are unintelligible.

(5) A reads शुल्वेन वा गन्धकीन हृतं. B reads मृतं.

[टीका—अथ चान्यकाराये, वंशवर्चनमा—]

शीतांशुवंशसम्भवहेहयकुलजन्मजनितः स महिमा ।

जयति श्रीमदनरयः किरातनाथो रसाक्षरः ॥

[टीका—अथ चास्य कारायेतुर्गुणवर्चनमा—]

यस्य दयमवतोष्णी रसविद्या सकलमङ्गलाधारा<sup>3</sup> ।

परमश्रेयसहेतुः श्रेयसि परमेष्ठिनः पूर्वम्<sup>4</sup> ॥

येन चतुर्वर्णश्लेष्मादिव्याधादिलब्धसत्त्वाभम्<sup>5</sup> ।

दक्षिणरसा गृहीता<sup>6</sup> आदिवराहेष्वेव महाप्रलये ॥<sup>7</sup>

(1) कुल is not found in B.

(2) स जयति श्रीमदनरयः, a variant in B.

(3) C reads सकलमङ्गलाधारा.

(4) Of the latter half C has only परं सहेतुः.

(5) C reads चतुर्वर्णश्लेष्मादिव्याधादिलब्धसत्त्वाभम्, which seems to be incorrect. Cf. Patala I., in which the following verse is given :—किरातगोपादिकतापसाश्वमेधराक्षसकुलप्रसाक्षयान् । विदंति नानाविधभेदजानां प्रमाणवर्णाङ्गतिनामजातीः ॥

(6) दक्षिणरस गृहीता is the incorrect reading in C. [In the case of किरातनाथ रसाः गृहीताः i. e. collected रस—mercury, minerals &c. and दक्षिण is favorable ; and in the case of आदिवराह रसाः गृहीता i. e. lifted up the earth.]

(7) This verse and the next are not found in B.

नष्टशरोरविषं<sup>१</sup> हीमाङ्गः कुडिनी गुणद्वयस्य ।

अभिनवसोभितरताभाः रपि पुनर्मवेरङ्गेः ॥

[टीका—कर्त्ता खनाभमं त्वं सूचयन्नाह—]

तस्मात् । केरातः प्रतीः बहुमानमवाप्य रससुकर्षीरतः<sup>१</sup> ।

रसहृदयार्थं तन्म<sup>२</sup> विरचितवा- भिष्णुगोविन्दः<sup>३</sup> ॥

नम्रा मा-लविष्णाः मनोविष्णोः सुतेन तन्वीऽयम्<sup>४</sup> ।

ोपोदितेऽस्तः<sup>५</sup> तथागतः श्रेयसे भूयात् ॥<sup>६</sup>

अष्टादशसंस्कारं रसेन्द्रदेवस्य दिव्यतनु इष्टा ।

लिखितमिदं पुष्पतमं रसहृदयमवाप्यते सकलम् ॥

(1) C reads रसकर्षोपदीयतो इष्टा, which destroys the metre.

(2) C reads रसहृदयार्थं, which seems to be incorrect.

(3) C reads विरचितायां भगवद्गोविन्दः, which is incorrect.

(4) C has रसाट्ठजान तन्वीयम्, which is incorrect.

(5) C has श्रीनन्दभगवद्गोविन्देन ज्ञतं, which mars the metre.

\* (6) This verse and the next are not found in B.

इति श्रीमद्भगवद् गोविन्दविरचितं

रसहृदयं समाप्तम् ।

समप्तम् ।

संवत् १६०४ समये ज्येष्ठ वदि १३ भौमि

जगन्नाथभट्ट लेखि ॥

श्रीराम हाल संवत् १८८० पीव वदि ३ भौमि ।

(1) MS. A ends abruptly with the colophon, which runs thus :—इति श्रीगोविन्दभगवत्पादविरचिते रसहृदये जीवैरस-  
क्रियाधिकार एकविंशतितमः पटलः ॥ The author's account  
of himself is altogether wanting in it. B has “इति सकल-  
रसवैयक्यलक्षिरीटशुभाकम्पासकव्यादयोराम सकलविद्यापारीश्वर श्रीमद्-  
भगुगोविन्दकृती रसहृदयः समाप्तः । इति श्रीमत्कृष्णवैद्यपयोधिसुधाकर-  
मिश्रमहोपाध्यायश्रीचतुर्भुजविरचितायां ... .. सुखे वाक्का-  
न्यवबोधिकाख्यायां रसहृदयटीकायां रसप्रसंगात्त एकविंशोऽवबोधः ।  
इति श्रीः” ॥

# Extracts from KAKACHANDESVARIMATA.

काकचण्डेश्वरामततन्वात्

समुद्धृताः श्लोकाः ।

ॐ नमः सदाशिवाय ।

कौलासशिखरासीनमुमा रुद्रं जगद्गुरुम् ।

क्रन्दनंदीमहाकाली भृंगचण्डीविनायकौ ॥ १ ॥

गोपिलोत्पलौ तत्र गुह्याद्गुह्यतरं परम् ।

कपाली कालरात्री च कालचंद्रकलाम्बिका<sup>१</sup> ॥ २ ॥

कराली कालकर्णी<sup>२</sup> च काकचण्डेश्वरी तथा ।

एवमाद्या चान्या योगिनीगणगुह्यकैः<sup>३</sup> ॥ ३ ॥

(1) The text reads कालचंद्रकलाम्बिका, which is incorrect.

(2) The text reads कर्णी, which is incorrect.

मृत्यवाद्यसुखेयानैः सानन्दैर्हृतेभ्यः ।

तत्रस्थं भैरवं देवं योगिनीगणवेष्टितम् ॥ ४ ॥

केचित् सुवन्ति संहृष्टाः केचिद्व्यायन्ति गुह्यकाः ।

केचिद्वृत्यन्ति गुह्या ये केचिद्व्यायं कुर्वते ॥ ५ ॥

हृषितं भैरवं देवं पंचवक्त्रं त्रिलोचनम् ।

तं दृष्ट्वा भैरवी हृष्टा जगतां प्रिद्विष्यते ॥ ६ ॥

कृताञ्जलिपुटा भूत्वा क्षणतारकलाचना ।

काकचण्डेश्वरी देवी उवाचेदं तु भैरवी ॥ ७ ॥

काकचण्डेश्वरी उवाच ।

भगवन् देवदेवेश सर्वज्ञ सर्वविष्टिवः ।

सर्वज्ञानप्रकाशाय चहं पृच्छामि शंकर ॥ ८ ॥

कथं कायस्थितो जीवो जीवकोऽसौ प्रकीर्तितः ।

कायस्थः कर्मणा केन स्थितः संसारपंजरे ॥ ९ ॥

जराव्याधिदारिद्रेण ग्रस्तः संसारबंधनैः ।

एको व्रजति यामेन एकः स्वंधे वहेच्च तम् ॥ १० ॥

(1) The text reads हृष्टं, which is not correct.

(2) The text reads सर्वविष्टिवः, which is not correct.

जयजयशब्दं सांगम्यमेकं न च जंतवः ।

किं कुर्वाणः प्रकुर्वाणः कर्माद्ये ब्रूहि संकर ॥ ११ ॥

श्रीसर्वज्ञ उवाच ।

शृणु त्वं काकचामुंडे साधकानां हितं प्रिये ।

गुह्याद्गुह्यतरं वाक्यं दृष्टोऽहं तु वरानने ॥ १२ ॥

कथयामि समासेन शृणु त्वं काकचंडिके ।

यस्यार्थश्च परो नित्यः अनादिनिधनेश्वरः ॥ १३ ॥

सुरूपो निर्गुणः शांतो विश्वव्यापी परात्परः ।

आदेवतैर्लोकैः कायस्थो भवते तु सः ॥ १४ ॥

जीवे व्याधिभयं कर्म भक्षानात् संप्रकौर्षितम् ।

तस्मात् कर्मभवात् क्षिष्टः संसारे संसरेत्तु सः ॥ १५ ॥

करोति<sup>१</sup> विविधं कर्म संसारे कामभीतिः ।

द्रव्योपायं न जानाति कामभीत्याद्यहेना ॥ १६ ॥

काय<sup>२</sup>क्षेत्रेण मानव्यो द्रव्योपायं करोति सः ।

विषयाच्चन्वयेवायां मेषाविज्ञयेविक्रये ॥ १७ ॥

(1) The text reads काकचंडे, which is incorrect.

(2) The text reads करोतु, which is not accurate.

(3) The text reads कायक्षेत्रेण, which is not correct.

वहन्ति काष्ठभारांश्च स्रजभाराननेकान् ।  
 यानं यवनच्छब्दं<sup>१</sup> च किं करोति<sup>२</sup> करोति सः ॥ १८ ॥  
 कामासक्तनरः श्रीमान् कुर्वते कर्म नैकधा<sup>३</sup> ।  
 कुर्वाणाश्च नराः केचित् कामासक्तार्थेन च ॥ १९ ॥  
 जायन्ते मर्त्यलोकेऽस्मिन् दारिद्र्योपहतचेतसः ।  
 जायन्ते नात्र संदेहो राजसंजा नपुंसकाः ॥ २० ॥  
 महासंसारबंधेन त्रिगुणेन सूर्यचिताः ।  
 चटव्यां घोरसंघट्टघाटिकां तु नयन्ति तत् ॥ २१ ॥  
 एतत्ते कथितं भद्रे यत्त्वं मां परिपृच्छसि ।  
 । केमन्त्रं पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ २२ ॥  
 इति काकः । ते प्रथमः पटलः ।

श्रीकाकचरी उवाच ।

कथयस्व महादेव कामभोगप्रसाधनः ।  
 अर्थः संपद्यते येन अक्षेयात् परमेश्वर ॥ १ ॥

- (1) The text reads यवनच्छब्दं, which has no sense.
- (2) The text reads किं करोति, which is incorrect.
- (3) The text reads कुर्वते कर्मनैकधा, which is incorrect.

तदहं श्रोतुमिच्छामि कथयस्व प्रसादतः ।  
 आकाशगमनं देव खेचरत्वं यथा भवेत् ॥ २ ॥  
 पांकाया दले पंचदिव्यस्त्रीकामसाधनम् ।  
 रोचनं अञ्जनं चैव धातुवाटरसायनम् ॥ ३ ॥  
 जलूकाबंधमित्याहुः रसस्य मारणं कथम् ।  
 जारणं रत्नकर्तृत्वं वज्रभद्रावणं कथम् ॥ ४ ॥  
 एतत् सर्वं समासेन ब्रूहि मे त्रिपुरांतक ।

श्रीभैरव उवाच ।

शृणु त्वं काकचामुंढे साधकानां हितं प्रिये ॥ ५ ॥  
 कथयामि समासेन पृथक् सिद्धार्थसाधनम् ।  
 न द्रव्येण विना सिद्धिर्न भोगाः काम एव च ॥ ६ ॥  
 द्रव्यहीना नरा मर्त्ये प्रेतरूपेण संस्थिताः ।  
 अटन्ति मर्त्यलोकेऽस्मिन् पर्युपद्रवकारणम् ॥ ७ ॥  
 \* \* \* विवं (?) तेषां जायतोपि मृतश्रुतेः ।  
 कुलं सौभाग्यरूपं च पांडित्यं ज्ञानसंस्थितम् ॥ ८ ॥  
 द्रव्यहीना न शोभन्ते प्राणहीना नरा यथा ।  
 कुक्षितो घ्राणहीनोपि केनापि वधिराः स्थिताः ॥ ९ ॥

पद्यंति मर्त्यलोकानि- द्रव्यस्य मकरध्वजम् ।  
 तस्मात् संसाधयेद्देवि रसेन्द्रं साधकोत्तमः ॥ १० ॥  
 अथातः संप्रवक्ष्यामि रसेन्द्रसाधनं तव ।  
 मारणं जारणाद्यं च द्रव्यसाधनमुत्तमम् ॥ ११ ॥  
 वज्रदंडः सुदंडश्च लोहदंडस्तथैव च ।  
 त्रयो विना शोधधये रसस्य मारणे हिताः ॥ १२ ॥  
 तान्निबोध समासेन यथा जानन्ति साधकाः ।  
 वज्रदंडसु वज्री स्यात् लोहदंडं पुटं विडः ॥ १३ ॥  
 सुदंडं ब्रह्मदंडं च समासात् कीर्तितं तव ।  
 ग्राहयेत्तं समासेन साधको हृष्टमानसः ॥ १४ ॥  
 तद्रसं रससंयुक्तं एकीकृत्य तु मर्दयेत् ।  
 अंधमूषागतं धातुं रसं म्रियेत तत्क्षणात् ॥ १५ ॥  
 सहस्रवेधी कर्त्ता च ज्ञायते स महारसः ।  
 मूषां संक्षेपयेत् तेन पुरागृह्य महीषधीः ॥ १६ ॥  
 अंधायित्वा- मध्ये तु रतिबंधः अयं विधिः ।  
 पश्चात् पलसहस्रैकं शुक्लस्य ग्राहयेद्दुधः ॥ १७ ॥  
 अश्ववर्गहतं शुक्लं चारवर्गहतं शुभम् ।  
 वज्रीक्षीरार्कक्षीरेण मर्दयेत् शतधा नरः ॥ १८ ॥

पुटं दद्यात् समासेन कालेनापि तं भवेत् ।  
 मूषागर्भोदरे चित्ता भ्रामयेत् ॥ १८ ॥  
 रसेन्द्रः क्षियते तत्र तारं संजायते चयात् ।  
 अथातः संग्रवकामि मूषाबंधं यथा भवेत् ॥ २० ॥  
 मृत्तिकाः प्राहयेत् मात्रं चयाजं चयाजताः ।  
 तुषादग्धास्रयो चाद्या सुदुर्भागास्तु चयस्तथा ॥ २१ ॥  
 एकीकृत्य तु संबन्धे मूषां तत् कारयेद्बुधः ।  
 गोस्तनाकारसहयोगेन सुखं ॥ २२ ॥  
 मूषाबंधमिति क्वातं साधकानां हिताय वै ।  
 अथान्यत् संग्रवकामि रसस्य मारुतं यथा ॥ २३ ॥  
 प्राहयेत् पूर्ववद्भूयः शोधधीस्तिस्रः साधकः ।  
 मूषां संक्षेपयेत् तेन धाम्य कर्म समाचरेत् ॥ २४ ॥  
 रसेन्द्रो क्षियते क्षिप्रं सुखं कर्म यदिच्छया ।  
 वीतोदकीन कामिना निजभाषि वा मृष्ट ॥ २५ ॥  
 कारयेत्तोहमयं पात्रं तच्छोर्ध्वं मृत्तयं शुभे ।  
 अन्धोऽन्य उल्लङ्घ्य कारयेत् साधकोत्तमः ॥ २६ ॥  
 अधोऽन्येन तं धाम्य चात्यसं तत्र कारयेत् ।  
 तस्य शोभते पुटं जरते नात्र संग्रयः ॥ २७ ॥

तद्गुणं आयसं तत्र हेमं चाष्टगुणं ददेत् ।

क्षीरवत्त्वं तथा चारी षट्जारी उदिरवत् । (?)

प्राप्त्यित्वा रसं तेषां आयसं जारयेन्नरः ॥ २८ ॥

हेमं संजायते तत्र धर्मकामार्थसाधनं ।

गृह्य खल्वोदरे तप्ते हेमं षड्गुणतां भजेत् ॥ २९ ॥

पुरा महीषधैर्युक्तं जरते नात्र संशयः ।

जारिते सारितं दद्यात् पुनस्तं जारयेद्यदि ॥ ३० ॥

कुरुते कर्मसंघांस कर्म सिद्ध्यर्थसाधनं ॥ ३१ ॥

जारणं मारणं चैव समासात् कीर्तितं मया ।

किमन्यत् पृच्छसे भद्रे तथा ते कथयाम्यहम् ॥ ३२ ॥

इति श्रीकाकचंडिखरीमते द्वितीयः पटलः ।

अथान्यं संप्रवक्ष्यामि अन्नकस्य यथाक्रमम् ॥ २० ॥

द्रावणं अन्नकस्यैव समासेन विधीयते ।

क्षीरकांशुकिचूर्णेन तद्रसेनाभिभाषितं ॥ २१ ॥

निर्गुणोवक्ष्यदण्डं तु तद्रसे भाषितं कुरु ।

एकैकां सप्तवारैस्तु भावयेत् साधकोत्तमः ॥ २२ ॥

(भावनास्ते) अन्नकस्य अन्ते क्षिपेद्दिनत्रयं ।

ब्रह्मत्वा सप्तरात्रं तु क्षिपेदन्नं नरोत्तमः ॥ २३ ॥

तेन कल्केन पचाणि लेपयेदभ्रकस्य च ।

कांस्यः । चेष \* \* \* स्तारि साधकोत्तमः ॥ २४ ॥

सूर्यधान्नि ततो धाप्यः सप्ताहं साधकोत्तमः ।

द्रवते नात्र संदेहः प्रियं दृष्ट्वा यथा स्त्रियः ॥ २५ ॥

रसस्य भागमेकं तु द्रुतभागसमं कुरु ।

एकीकृत्य तु तद्याभ्यं म्रियते नात्र संशयः ॥ २६ ॥

सङ्काशवेधकोऽसौ हि जायते नात्र संशयः ।

अथान्यं संवक्ष्यामि यथा संजायते द्रुतिः ॥ २७ ॥

ग्राहयेदभ्रकं प्राज्ञः पीतं वा कृष्णमेव वा ।

रासंस्कारयुक्तं तु कर्तव्यं साधकेन तु ॥ २८ ॥

यवासा चित्रकं धारः कंचुकीवज्रदंडयोः ।

वज्रकंदार्कचौरं च भक्तातं टंकणं तथा ॥ २९ ॥

चारनयसभा तं पटुं कर्तव्यं ।

एकीकृत्य तु कल्केन चक्रपचाणि लेपयेत् ॥ ३० ॥

मूषागर्भोदरे चित्रा धामयेत् सुदिरामलैः ।

द्रवते नात्र संदेहो \* \* \* \* \*

इति का. चंडिकासमते षष्ठः पटलः ।

# Extracts from RASENDRACHUDAMANI.

सोमदेवविरचितात् रसे-च्छुडामयोः

उद्धृताः श्लोकाः ।

रूप्येण सह संयुक्तं धातं रूप्येण चेत्यगीत्<sup>1</sup> ।

तदा निरालम्बं लोहं तदपुनर्भवम् ॥

एवं रूप्यं समागं चेत् धातं ताम्ने लगेच्छि ॥

निष्कमात्रे तु नागेऽस्मिन् लोहस्यार्थां हते सति ।

स्वतो लक्षगुणां हैमीं शलाकां यसति ध्रुवम् ॥

कुसुमैलतमं तत् स्वर्णमुद्गिरति<sup>2</sup> ध्रुवम् ।

गुह्यनागोऽयमुद्दिष्टो वक्ति<sup>3</sup> स्वच्छन्दभैरवः ॥

(1) The text reads लघु. But रसरत्नसमुच्चय reads चवेत्, which seems to be correct.

(2) The text reads लघं मुद्गिरिं, which is incorrect.

(3) The text reads मुद्दिष्टवक्ति, which has no sense.

तीक्ष्णं त्रिभुजं भ्रातं हि बहुशो दृढम् ।  
 मृदुलानां द्रुतद्राव<sup>1</sup> वरनागं तदुच्यते ॥  
 मृतस्य पुनरुद्भूतिः संप्रोक्तोत्थापनाख्यया<sup>2</sup> ।  
 द्रुतद्रव्यस्य निक्षेपो द्रवे तद्दालनं मतम् ॥  
 त्रिंशत्पलमितं नागं भानुदुग्धेन मर्दितम् ।  
 विमर्द्य पुटयेत्तावत् यावत् कर्षावशेषितम् ॥  
 न तत् पुटसहस्रेण क्षयमायाति सर्वथा<sup>3</sup> ।  
 चपलोऽयं समुद्दिष्टो वार्त्तिकैर्नागसम्भवः<sup>4</sup> ॥  
 इत्थं हि चपलः<sup>5</sup> कार्यो वङ्गस्यापि न संशयः ।  
 तत्सृष्टहस्तसंसृष्टः केवलो बध्यते रसः ॥

(1) The text has द्रुतद्रावौ, which is incorrect. We have adopted the text of रसरत्नसमुच्चय.

(2) The text reads साधोक्तस्थापनाख्याया, which seems to be erroneous.

(3) The text has क्षयमायान्ति सर्वथा, which is grammatically incorrect.

(4) The text reads नागसम्भवः, which is incorrect.

(5) The text reads इत्थं चौरपलः, which is senseless.

स रसो धातुवाद्देशु शस्यते न रसायने<sup>1</sup> ।  
 अयं हि स्वर्पणाख्येन<sup>2</sup> लोकनाथेन कीर्तितः ॥  
 भ्रामकाख्यरजः सूक्ष्मं प-भांशरसान्वतम् ।  
 कुमारौमूलतोयेन मर्दयेदेकवासरम् ॥  
 चाङ्गेरीस्वरसेनापि दिनमेकमनारतम्<sup>3</sup> ।  
 एवं भूनागधातेन मर्दयेद्विसद्वयम् ॥  
 अथैकपलमानेन तावता त्रपुणापि च ।  
 दशनिष्करसेन्द्रेण क्षणपिष्टीं समाचरेत् ॥  
 योजयित्वाय कल्केन यथापूर्वं विमर्दयेत् ।  
 ततः साररसेन्द्रेण सत्त्वेन रसकस्य च ।  
 पिष्टीं कृत्वा तु पूर्व्वेण पूर्व्वकल्केन योजयेत् ॥  
 अथ प्रक्षाल्य कोष्ठेन<sup>4</sup> कान्तिकेन प्रयोषयेत् ।

(1) The text has रसायनम्.

(2) स्वर्पणाख्येन is the reading in रसरत्नसुचय.

(3) The text reads दिनमेकमनारतम्, which has no clear sense.

(4) The text reads कोष्ठेन, which is unintelligible.

पलाईशुद्धसस्त्रेन शृष्टगुञ्जारसेन च ।  
 विमर्द्य काष्ठीके कुर्यात् मरिचप्रमितां गुटीम्<sup>1</sup> ॥  
 निरुध्य वज्रमूषायां सन्धिवन्धं विधाय च ।  
 पिरेर्नवभिः<sup>2</sup> सम्यग्भस्त्राभ्यां च धमेत् खलु ॥  
 ततो मूषागतं सत्त्वं समादाय समन्ततः ।  
 धमेत् प्रकटमूषायां वज्रनालेन शुद्धये ॥  
 दशग्राहं हि तत्सत्त्वं भस्त्रना लवणेन च ।  
 सकाष्ठीकेन संवेष्ट्य पटयोगेन शोधयेत् ॥  
 द्विनिष्कप्रमिते तस्मिन् पूर्वप्रोक्तेन भस्त्रना ।  
 अशीतिगुणितं नागं ध्यात्वा निर्वाहयेत् खलु ॥  
 इयता<sup>3</sup> पूर्वसूतोऽसौ जीयते न कथञ्चन ।  
 चपलोऽयं समुद्दिष्टो लोकनाथेन शम्भुना ॥  
 अनेनापि रसः शीघ्रं बध्यते पूर्ववत् खलु ।  
 पुटितो हि सः ।  
 भवेज्जागविनिर्मुक्तो ग्रासं गृह्णात्यशेषतः ॥

(1) The text reads मरिचप्रमिता गुटी, which is incorrect.

(2) The text reads द्विनिर्नवभिः, which has no sense.

(3) The text reads इयता, which is incorrect.

मुखं प्रकटमूषायां भवेच्च विगुणोत्तरम्<sup>1</sup> ।  
 जीर्णवासो रसो ह्येष देवता- करो भवेच्च ॥  
 सोऽयं श्रीसोमदेवेन कथितोऽतोवनिनि<sup>2</sup> ॥  
 भृशुजङ्गमस्तोयैः<sup>3</sup> प्रचाख्याय तं<sup>3</sup> रजः ।  
 लाणावर्णं हि तत् प्रोक्तं धीतासु<sup>4</sup> रसवादिभिः ॥

स्वरूपस्य विनाशेन ।पेष्टतायां न हि यत् ।  
 विप्रुर्द्विर्वर्जितः<sup>5</sup> सूतो नष्टपिष्टः स उच्यते ॥  
 अथ यन्त्राणि वक्ष्यन्ते रसतन्त्रा- यनेकशः<sup>6</sup> ।  
 समालोक्य समाखेन सोमदेवेन सांप्रतम् ॥

- (1) The text reads विगुणोत्तरा, which is incorrect.
- (2) The text reads तयि, which is not accurate.
- (3) The text has अपङ्कतं, which is not accurate.
- (4) The text reads धीतासुं, which is not correct.
- (5) But रसरससमुच्चय reads विप्रुर्द्विर्वर्जितः.
- (6) But रसरससमुच्चय reads अपङ्कतः.

जङ्घपातनयन्त्रं हि नन्दिना परिकीर्तितम् ॥

कोष्ठि(ष्टि)कायन्त्रमेतद्दि नन्दिना परिकीर्तितम् ॥

विन्ध्याद्रौ हिमपर्वते च मलये गोमन्तके श्रीगिरौ  
सङ्खाद्रावथ पारियात्रकगिरौ किङ्किंधिनामालये ।  
माहेन्द्रेऽथ चाल्पवत्क्षितिधरे तद्रूपनामाधिकं  
गोपाभीरकसिद्धवैद्यमुखतो वैद्यः समावेद्यताम् ॥

इति श्रीकरवालभैरवपुरवरपतिश्रीसोमदेवविरचिते  
रसेन्द्रचूडामणौ रससूत्रस्थाने रसमहिम-  
निरूपणं नाम प्रथमोऽध्यायः

समाप्तः ।

Extracts from  
**RASAPRAKASASUDHAKARA.**

यशोधरविरचितात् रसप्रकाशसुधाकरात्

उद्धृताः श्लोकाः ।

विमलसूतवरो हि पलाष्टकं

तदनु धातुघटीपटकांक्षिकाः ।

पृथगिमाञ्च चतुःपलभागिकाः

स्फाटिकरश्मिपलाष्टकपलाष्टकाः ।

सह जलेन विमर्द्य च यामकं

संवण्णकम् । जलेन विमिश्रितम् ।

उदितधातुगणस्य च मूषिकां

कुरु रसं विनिवेशय तच्च वै ।

उमरुकाभिधयन्मवरेण तं

हिदशयाममजाचयवह्निना ।

पलाष्टकपलाष्टकचयकारकं

सकलरागहरं परमं सदा ।

गजपतेर्बलवत् बलदो वृषां

द्विजपतोच्चैश्च यनप्रदः ।

युवतिकामविलासविधायको

भवति सुतवरः सुखदः सदा ।

सघनसाररसः किल कान्तिद-

स्वखिलकुष्ठहरः कथितो मया ॥

इति कर्पूररसः ।

उदयभास्करनामरसो ज्ञेयं

भवति रोगविधान्तकरः स्वयम् ।

मगधिकामधुना सह गुञ्जिका-

चयमितश्च सदा परिसेवितः ।

सलितकामविलासविधायकः

यविरकाऽपि रती तक्ष्णायते ॥

गदहरो बलदोऽपि हि वर्षदो

भवति कर्मविपाकजरीगण्ठा ।

सकलसूतकशास्त्रविमन्वजो

द्विजवरेण मया प्रकटीकृतः ॥

इति उदयभास्कररसः ॥

अधेदानीं प्रवक्ष्यामि धातुशोधनसारणम् ।  
 अनुभूतं मया किञ्चित् किञ्चिच्छास्त्रानुसारतः ॥  
 सुवर्णं रजतं चेति लोहं शुचमुदीरयेत् ।  
 ताम्रं चैवाश्रमसारञ्च नागवल्ली तथैव च ॥  
 तोष्यलोहं निगदितं हितयं रसवेदिभिः ।  
 समिश्रलोहचितयं सौरा रोतिवर्तकाः ।  
 एतेऽष्टौ धातवो ज्ञेया लोहान्येवं भवन्ति हि ॥

अथ रसकगुणाः ।

द्विविधो रसकः प्रोक्तः कारवेक्षक-दुर्दुरः<sup>1</sup> ।  
 सत्त्वपाते परः प्रोक्तः प्रथमखीषधादिषु ॥  
 स तु<sup>2</sup> मेहहरयैव पित्तश्लेष्मविनाशनः ।  
 रञ्जनः पारदस्याथ नेत्ररोगक्षयाय<sup>3</sup> ॥

(1) The text reads कानी बलवदुदुरः, which appears to be incorrect.

(2) The text reads सत्त्व, which seems to be incorrect.

(3) The second hemistich is wanting in the text.

We have adopted the reading of रसरससुख्य.

पारदो रसकश्चैव त्रैलोक्योद्धरणवृत्तौ ।  
 नागार्जुनेन कथितौ सिद्धौ श्रेष्ठौ रसावुभौ ॥  
 कृतौ येनाग्निसहनौ सूतखर्परकौ शुभौ ।  
 तेन स्वर्णमयी सिद्धिरर्जिता<sup>1</sup> च न संशयः ॥  
 रसको द्रावितः सम्यक् निक्षिप्तो रसपूरके ।  
 निर्भलत्वमवाप्नोति सप्तवारं निमज्जितः<sup>2</sup> ॥  
 काञ्चिके वाय तक्ने वा नृमूत्रे<sup>3</sup> मेषमूत्रके ।  
 द्रावितं क्षालितं<sup>4</sup> सम्यक् खर्परं परिशुध्यति ॥  
 खर्परं रेचितं शुद्धं स्थापितं नरमूत्रके ।  
 रञ्जयेन्मासमेकं हि ताम्रं स्वर्णप्रभं वरम् ॥

(1) The text reads सिद्धौ राजिता, which is not accurate.

(2) The text reads निमज्जितं, which is incorrect.

(3) The text has only मूत्रे, which mars the metre.

(4) द्राविते क्षालिते is the reading of the text, which is evidently an error.

वचाहरिद्रानिफला-गृहधूमैः ससैन्धवैः ।  
 भस्मातकैष्टङ्गणैश्च चारैरान्त्रैश्च महितम्<sup>1</sup> ॥  
 पाटांशसंयुतैर्मूषां हृत्ताकफलसन्निभाम् ।  
 निरुध्य शोषयित्वा च मूषामुखोपरि न्यसेत् ॥  
 प्रधाते खर्परे ज्वाला सिता नीला भवेद्यदि ।  
 लोहसंदंशके मूषां धृत्वा क्षत्वा ह्यधोमुखीम् ॥  
 भूम्यामाढालयेत् सत्त्वं यथा नालं न भज्यते ।  
 तदा सीसोपमं<sup>2</sup> सत्त्वं पतत्येव न संशयः ॥  
 अनेनैव प्रकारेण वारत्रयकृते सति ।  
 विनिःसरेत् सर्व्वसत्त्वं सहिंशु(?) गुरुणोदितम् ॥  
 अथ सौराष्ट्रीगुणाः ।  
 सौराष्ट्रदेशे सञ्जाता खनिजा<sup>3</sup> तुवरी मता ।  
 या लेपिता श्वेतवस्त्रे रङ्गबन्धकरौ हि सा ॥

(1) The text reads वजितं, which seems to be incorrect.

(2) रसरत्नसमुच्चय says बज्जामं. See Chap. II. Verse 161.

(3) The text reads खनिता, which is incorrect.

फुल्लिका खटिका<sup>1</sup> तद्वत् द्विप्रकारा प्रचक्षते ।  
 किञ्चित् पीता च सुस्निग्धा गरदोषविनाशिनी ॥  
 श्वेतवर्णा परा साक्षा फुल्लिका खो भारणी ॥  
 कषाया मधुरा काण्ठी कटुका विषनाशिनी ।  
 त्रयस्त्री कफहा चैव नेत्रव्यापचिरोपहृता ॥  
 कण्ठरोमहरा सा तु पित्तदे वीजजारणी ।  
 धान्यान्ने तुवरी क्षिप्ता शुध्यति किदिनेन वै ॥  
 चारैरान्नेश्च मृदिता भाता सत्त्वं विमुच्यति ।  
 तत् सत्त्वं धातुवादायै शीषधे नोपपद्यते ॥  
 अथ पुटानि लिख्यन्ते ।  
 भूम्यां वै खन्यते गर्तं द्विहस्तं चतुरस्रकम् ।  
 हृण्णेन सहस्रेण पुटैस्तद्व्याप्तम् ॥  
 शीषधं धारयेन्मध्ये तदाच्छाद्य वनोपलैः ।  
 सहस्राक्षेण वै सम्यग्वक्त्रिं प्रज्वालयेत्ततः ॥  
 महापुटमिदं प्रोक्तं ग्रन्थकारेण निर्णितम् ॥  
 इति महापुटः ॥

(1) रसरत्नसमुच्चय says कटुकी फुल्लिका.

एक क्षाममासं हि चतुरस्रं च गर्तकम् ।  
 वनोपलस्य क्षेत्रे गर्तमध्यं च पूरितम् ।  
 मूषिकां ~~लेह्या~~ पूरितां तां तु मुद्रयेत् ।  
 गर्तमध्ये ~~विधाया~~ गरिणि<sup>1</sup> च निक्षिपेत् ॥  
 ऊर्ध्वान्निं ज्वालयेत् सम्यक् सोऽयं गजपुटो भवेत् ॥  
 इति गजपुटः ॥

उपलं पिष्टकं छाद्यमुत्पलस्य गरिण्यकम् ।  
 हगणोपलसारी च तचरा<sup>2</sup> हगणाभिधाः ॥  
 भरनिमाणे कुंडे च वाराहपुटः स्यते<sup>3</sup> ॥  
 इति वाराहपुटः ॥

वितस्त्रिद्वयमग्नेन गर्तं चैवचतुरस्रकम्<sup>4</sup> ।  
 कुकुटाख्यं पुटं विव्या ~~लेह्या~~ साधनम् ॥  
 इति कुकुटपुटः ॥

(1) रसरत्नसमुच्चय reads निरिच्छानि.

(2) रसरत्नसमुच्चय reads वराटी.

(3) The text reads भरनिमाणे कुंडे च वाराहपुटमध्यतः,  
 which seems to be incorrect.

(4) The text reads गर्तं कूर्वाचतुरस्रकं, which mars the  
 metre.

कृगणैरष्टभिः सम्यक् कपोतपुटमुच्यते ॥

इति कपोतपुटः ॥

तुषैर्वा गोवरैर्वापि रसभस्मप्रसाधनम् ।

माणिकाद्वयमानेन गोवरं पुटमुच्यते ॥

इति गोवरपुटः ॥

मृदुभाण्डे तु प्रपूयैव मध्ये द्रव्यं तु विन्यसेत् ।

अधस्ताज्ज्वालयेदग्निं मृदुभाण्डपुटमुच्यते ॥

इति (मृदु)भाण्डपुटः ॥

गर्त्तं तु बालुकापूर्णे मध्ये द्रव्यं तु विन्यसेत् ।

उपरिष्ठादधस्ताच्च वक्त्रिं कुर्यात् प्रयत्नतः ।

तद्बालुकापुटं सम्यगुच्यते शास्त्रकोविदैः ॥

इति बालुकापुटः ॥

मूषिकां भूमिमध्ये तु स्थापितां द्युल्लादधः ।

उपरिष्ठात् पुटं दद्यात्<sup>1</sup> तत् पुटं भूधराभिधम् ॥

इति भूधरापुटः ॥

(1) The text reads दत्ता, which is incorrect.

गोवरैर्वा तुषैर्वापि मात्राकर्षमितैः पुटम् ।

यत्र तस्मावकाख्यं स्यान्मृदुद्रव्यस्य साधने ॥

इति लावकाष्टः ॥

इति श्रीपद्मनाभसूनुश्रीयशोधरविरचिते

रसप्रकाशसुधाकरे दशमोऽध्यायः ।

-- --

अथातः संप्रवक्ष्यामि धातूनां कौतुकं परम् ।

स्नानुभूतं मया किञ्चित् श्रुतं यच्छास्त्रतः खलु ॥

तदहं कथयिष्यामि यत् कृत्वा ना सुखी भवेत् ॥

रसकं दरदं ताप्यं गगनं कुनटीसमम् ।

रक्तस्रुहीपयोभिश्च मर्दयेद्दिनसप्तकम् ॥

जलयन्त्रेण वै पाच्यं चतुर्विंशतियामकम् ।

तेन वेध्यं द्रुतं ताम्रं तारं वा नागमेव वा ॥

सह(शत)वेधो तु तत्कल्को जायते नात्र संशयः ॥

एकभागस्तथा सूतो वज्रवज्राथ मर्दितः ।

खले त्रिर्निष्याद्य रसे पञ्चभागसमन्विते ।

वेत्रयज्या च रागिण्या पीतकल्कं प्रजायते ॥

षोडशंशेन दातव्यं द्रुते ताम्ने सुशोभने ।

जायते प्रवरं हेम शुद्धं वर्णचतुर्दशम् ॥

इति हेमक्रिया ॥

स्वर्णमाक्षिकां संस्लेद्य काञ्चिके विवसत्ययम् ।

चर्मरंग्या(गा)रसेनैव मर्दयेद्दिनसप्तकम् ।

जलेन धीतं तावच्च यावद्धेमनिभं भवेत् ॥

दरदं रसदेशीयं<sup>1</sup> गोमूत्रेनैव स्वेदयेत् ।

लोलायन्त्रेऽङ्गि<sup>2</sup> चत्वारि पञ्चाङ्गुलतमो भवेत् ॥

मनःशिला पद्मनिभा रक्ता चैव सुशोभना ।

स्वेदिता मुनिपुष्पस्य रसेनैव तु दोलया ।

याममर्दमिता शुद्धा सर्वकार्येषु योजयेत् ॥

नवसारस्तथा सूतः शोधितोऽग्निमति स्थले ।

समभागानि सर्वाणि मर्दयेच्चिम्बुकारसैः ॥

मातुलुङ्गरसेनैव कुमारीसुरसेन वा ।

सूर्यातपे विमर्दोऽसौ पाचितो जलयन्त्रके ।

दिनानि त्रीणि तीव्राग्नीं कुप्यात्तद्वतारयेत् ॥

(1) The text reads रसदेशीयो, which is incorrect.

(2) अङ्गि [अङ्गानि] is grammatically incorrect.

शतांशं वेधयेत्तारं शुद्धहेम प्रजायते ।  
 जलमेदो यदा न स्वात्मानं कार्य्या विचारया ॥  
 शिलया मारितं नागं कुमार्याः स्वरसेन तु ।  
 पुटद्वादशयोगेन नागभस्म प्रजायते ॥  
 शतसंख्यानि वै कुर्यात् पुटान्येवं शरावके ।  
 कुमार्याः स्वरसेनैव भावयेत् ॥  
 पूर्व्ववत् पुटनं कार्य्यं शतसंख्यामितं तथा ।  
 सूतगन्धशिलादद्गुसमं चेन्नागभस्मकम् ।  
 त्रिंशद्द्वानोपलैर्दद्यात् पुटं वारहसंज्ञकम् ॥  
 अनेन विधिना सम्यक् शतसंख्यानि दापयेत् ।  
 पुटान्येवं कृते चीणि शतानि द्वादशाधिकम् ॥  
 पञ्चाङ्गुलं काचमये कूपे द्वात्रिंशद्यामकम् ।  
 बालुकाग्निं प्रदद्याच्च स्वाङ्गशीतं समुद्धरेत् ॥  
 तलभस्म गृहीतव्यं वेधयेत्तारं शुद्धहेम ।  
 शुद्धहेम भवेत्तेन नाच कार्य्या विचारया ॥  
 दृष्टप्रत्यययोगोऽयं कथितो नाच संशयः ॥

# Extracts from RASACHINTAMANI.

मदनान्तदेवसूरिविरचितात् रसचिन्तामणेः  
उद्धृताः श्लोकाः ।

सैश्वर्यं तोरिकां सूतं कासीसं लकुचद्रवैः ।

विष्टुष्य खल्वभाण्डस्थं सर्वश्लक्ष्णं । देवतयन् ॥ ७६ ॥

हृण्डिकायां तदारोप्य काष्ठवज्रिर्विधीयते ।

दिनत्रयेऽप्यतिक्रान्ते भस्म श्वेततरं भवेत् ॥ ७७ ॥

\* \* \* \* \*

• इति त्रयोदश भस्मसूतः ।

खर्परो द्वादशांशः स्यात् शिखिशीवं च तुल्यकं ।

षड्गुणं माक्षिकं नेत्रभागं ग्राह्यं मनःशिला<sup>१</sup> ।

भागत्रयमिदं ग्राह्यं शोभनागतकर्करैः<sup>२</sup> ॥ ३८ ॥

(1) अपि नेत्रभागा मनःशिला is the correct reading as stated in the margin of the text.

(2) त्रयो भागा अपि ग्राह्याः शोभना गतकर्कराः is the correct reading as stated in the margin of the text.

गन्धकत्रयमेवास्ते काचमाचौरसैर्भृशं ।

दिनसप्तात्र कर्षाया भावना मर्दनं क्रमात् ॥ ३८ ॥

अधोमुखेन यन्त्रेण तेन निःसारयेद्बुधः ।

सत्त्वं तद्रसकस्याथ दृढं कार्य्यकरं परं ॥ ४० ॥

अत्रयं तद्दृढं सत्त्वं निर्धूमं कर्मसाधनं ॥

इति रसकसत्त्वपातनं ।

त्रिवारं गन्धकहतं ताम्रहेमद्वयत्रयं ।

सत्त्वं तालस्य मासैकं योजयेत् सर्वकामदं ॥ ४३ ॥

अम्रवर्णं भवेद्धेमं ताम्रगन्धकमारितं ।

एतयोर्दीयते रम्यं जायते कांचनं शुभं ॥ ४४ ॥

इति ओमदनांतदेवविरचिते रसचिंतामणौ

हेमीकरणप्रयोगः ॥

पारदं सीसकं गंधं कुनटी तच्चतुष्टयं ।

वोजपूरांभसा पिष्ट्वा बाढं दिनचतुष्टयं ॥ १०८ ॥

अथ सूक्ष्माणि पञ्चाणि तेन तारस्य लेपयेत् ।

वोजपूररसेनैतत् अतिमात्राग्नितापितं ॥ १०९ ॥

एकाधिका भवंत्यत्र भूयनाद्यास्य विंशतिः ।

विशोष्णावर्त्तितं तारं भवेत्तारस्य कांचनं ॥ ११० ॥

इति चिंतामणौ हेमीकरणप्रयोगः ॥

हेमभागद्वयं तारं तथा ताम्रं चतुष्टयं ।

एकतः क्रियते पञ्चमत्तिसूक्ष्मं निरामयं ॥ १११ ॥

जंबीरनीरसंपिष्टं खर्परस्याष्टटंकणं ।

तेन तान्यथ पत्राणि लेपनीयानि वै बहु ॥ ११२ ॥

आवर्त्तते पुनर्दत्त्वा मूषके गलितानि च ।

तदा तानि भवंत्यत्र त्रिरूपाणि नान्यथा ॥ ११३ ॥

इति त्रिमीकरणप्रयोगः ॥

एकभागो भवेद्दारः तारं भागद्वयं भवेत् ।

वेदभागं भवेत्तीक्ष्णं सत्त्वं सत्वाच्च वै दश ।

वंमभागं भवेत्पत्रं सर्वमेकत्र कारयेत् ॥ १०८ ॥

टंकसेन पुनः धातं पत्रं कृत्वास्य वक्त्रगं ।

वेलाव्रयमिदं धातं तन्मध्ये निवेशयेत् ॥ ११० ॥

एवं तारं भवेन्नूनं परोक्षोच्चमभापने ॥

इति तारोत्पादकं ॥

तुल्यकं पिब्यते स्वस्वे त्रिफलाहिङ्गुटकसैः ।

मध्वाण्यमिश्रितं धातं सत्त्वं पातयते ध्रुवं ॥ ६८ ॥

इति तुल्यकसत्त्वपातनं ॥

खर्परः स्वेद्यते पूर्व्यं जलेन च ।

वटारोहजलेनापि पर्णचूर्णेन शोभनः ॥ ७५ ॥

गुडटंकणसंमिश्रस्त्रिफलाकायमर्दितः ।

मृन्मये कूपके कृत्वा धाम्यमानो भृशं च सः ॥ ७६ ॥

श्वेतधूमोद्गमे जाते तत उत्थाप्य कूपकं ।

सावधानं करेणैव भूमौ तं चाध आनयेत् ॥ ७७ ॥

पुनश्च धाम्यते कूपः तथाजातं च तं पुनः ।

कूपकं च पुनर्भूमौ तथा तं नामयेत् पुनः ॥ ७८ ॥

सत्त्वं खर्परकस्यैतत् नागरूपं पतत्यधः ॥ ७९ ॥

इति खपरसत्त्वपातनं ॥

# Extracts from RASAKALPA.

रुद्रयामलान्तगतात् रसकल्पादुद्धृताः

श्लोकाः ।

शिवं नत्वा रसाधीशं चण्डिकाचरणं तथा ।

क्रियते<sup>1</sup> रसकल्पोऽयं रसज्ञानविशारदः<sup>2</sup> ॥ १ ॥

॥ अथ परोक्षा ॥

अतेजा अगुरुः शुभ्रो लोहहा(ऽ)चञ्चलो रसः<sup>3</sup> ।

यदा<sup>4</sup> नावर्त्तयेदङ्गौ नोर्द्ध्वं गच्छेत्तदा मृतः ॥ ४०

(1) The text reads करंनि, which is grammatically incorrect.

(2) The reading in the text is विशारदम्, which is incorrect.

(3) The text reads रस, which is incorrect.

(4) The text reads यदामावर्त्तयेत्, which is not correct.

दन्ते शृङ्गे मणौ वेशौ रक्षयेत् साधितं रसम् ॥ ४२ ॥

इति श्रीरुद्रयामले रससंकीर्तकं नाम  
प्रथमोऽङ्काः ।

हेमरूप्यार्कवङ्गाहि<sup>१</sup> लौहा लोहाः<sup>२</sup> षड्वीरिताः ।  
अक्षत्रिमा इमे येषां वर्त्ताद्याः स्युस्तु<sup>३</sup> कृत्रिमाः ॥१॥

सन्तो बद्धाञ्जलिपुटो युष्मान् विज्ञापयाम्यहम् ।  
कृपासुधारसयुता दृष्टिर्ग्रन्थे प्रदीयताम् ॥  
महारसाः स्युस्तत्रादावष्टौ पारदहिङ्गुले ।  
वैष्णवं शस्यकं शैलं चपलं रसकोऽमलम् ॥

(महारसाः)

(1) The text reads वङ्गाहिः, which is grammatically incorrect.

(2) लौहिर्लोहा is the reading of the text, which seems to be incorrect.

(3) The text reads रसाद्यालक्ष्मिमा, which is palpably an error.

अभ्रकं तुल्यकं कान्तं राजावर्तमद्याञ्जनम् ।

वप्यं वैक्रान्तकं चैव टङ्गणं च रसा बहु ॥

(रसाः)

गन्धकं तालकशिले क्षितिखेचरगैरिकाः ।

इत्यादयश्चोपरसाः सर्वाचार्यैरुदीरिताः ॥

(उपरसाः)

सितासिता रणं पीतं गन्धकं तच्चतुर्विधम् ॥

तालकं द्विप्रकारं स्यात् गोदन्तः पाटलच्छविः<sup>1</sup> ॥

रक्ता पीता शिला द्वेधा पूर्वा श्रेष्ठोत्तराधमा<sup>2</sup> ॥

बहुप्रकारा सौराष्ट्री कासीसं त्रिविधं मतम्<sup>3</sup> ॥

कासीसं पुष्पकासीसं हीरकाङ्गीसमित्यथ ॥

गैरिको द्विविधः प्रोक्तः सौवर्णो लोहितस्तथा ॥

(1) The text reads पटलाच्छवि, which seems to be incorrect.

(2) पूर्वाश्रेष्ठोत्तराधमा is the reading of the text, which is incorrect.

(3) The text reads कासीसस्त्रिविधो मतः, which is incorrect; as it is mentioned neuter in the next line.

कङ्कठादीन्<sup>1</sup> रसान् केचिदाचार्या वर्षयन्ति वै ।  
अस्माभिरिह तन्नोक्तं मुनिमार्गानुसारिभिः ॥

इत्येष प्रोदितो मार्गो रसशोधनकर्त्तृभिः ।  
स्वच्छन्दैरवायुक्तो गोविन्दादिसमादृतः<sup>2</sup> ॥

लवणं चूलिकोद्भूतं गन्धकेन समन्वितम् ।  
सर्वार्द्रदृष्टं<sup>3</sup> चिचार्द्रं मूलभस्मप्रगालितम् ॥  
गोमूत्रेण शतं भाग्यं तद्रसे जारयेत् शनौ<sup>4</sup> ।  
तस्य संपर्कतः सूतो राक्षसो भवति ध्रुवम् ॥

(1) The text reads कङ्कठादीन्, which is an error of the scribe.

(2) The text reads समादृतः, which is incorrect.

(3) The text reads सर्वार्द्रदृष्टं, which seems to be incorrect.

(4) शनौ, as given in the text, is grammatically incorrect.

एतदेव विडं दद्यात् सर्व्वदा हेमजारणे<sup>1</sup> ।  
 मुखं संजायते तेन जीर्य्यते च<sup>2</sup> विनिश्चितम् ॥  
 इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे  
 रसशोधनप्रकारः ॥

इति संधानयोगोऽयं जारणेऽतिगुणावहः ।  
 प्रकाशितः संप्रदायक्रमप्राप्तः शिवोदितः ॥  
 इति श्रीरुद्रयामले रसकल्पे उमामहेश्वरसंवादे  
 रसाधिकरणो<sup>3</sup> नाम द्वितीयोक्तासः ॥

महारसानां सर्व्वेषां रसानां शुद्धिरुच्यते ।  
 तथैवोपरसानाञ्च शास्त्रदृष्टेन वर्त्मना ॥ १ ॥

कदलीपत्रजैर्नरैः माक्षीकं भावयेत् शतम् ।  
 गन्धर्वतैलमध्वाज्य-पक्वमेकं दिनत्रयम् ॥

- (1) The text reads हेमजारणौ, which is not correct.
- (2) The text reads न, which appears to be an error.
- (3) The text reads रसाधिकारिणा, which is incorrect.
- (4) The text reads शतं, which is senseless.

तत्ताप्यं वज्रमूषायां<sup>1</sup> पक्तायां निक्षिपेत्ततः ।  
 लोहसन्धानकरणं तत्समं तत्र निष्पचेत् ॥  
 दृढां प्रकल्पयेन्मूषां<sup>2</sup> कोटिके<sup>3</sup> विानेवेशेत् ।  
 अङ्गारैः खदिरोद्भूतैः धमेद्भस्त्राद्वयेन वै ॥  
 वक्रनालयुजा सत्त्वं ताप्यस्य पतति ध्रुवम् ॥  
 शुक्लदीप्तिः सशब्दश्च<sup>4</sup> यदा वैश्वानरो भवेत् ।  
 तदा सत्त्वं तु पतितं जानीयान्नान्यथा क्वचित् ॥

रसकं खेदयेदादौ<sup>5</sup> पटुचूर्णकृतं बुधः ।  
 चतुर्गुणिन वस्त्रेण दृढं बध्वा च डोलिकाम् ॥

(1) तत्ताप्यं वज्रमूषा is the reading of the text, which appears to be incorrect.

(2) The text प्रकल्पयेन्मूषां is evidently incorrect.

(3) कोटिकानि निवेशयेत् is the reading of the text, which has no meaning at all.

(4) The text reads सशब्दश्च, which is grammatically incorrect.

(5) रसकांशदयेदादौ is the reading of the text, which seems to be incorrect.

कृत्वा भाण्डे च सजले<sup>1</sup> खेदयेन्मासपञ्चकम् ।  
 उद्धृत्य पश्चाद्रसकं खल्लमध्ये<sup>2</sup> । वेचू टिप्पू ॥  
 गालीयान् मालतीजातं सगुडं जीर्णगुञ्जकम् ।  
 गृहधूमं रेवकीं च निशामं कुसुमजीरकान्<sup>3</sup> ॥  
 तत् सर्वं चूर्णितं कृत्वा गोपंचकविभावितम् ।  
 कृत्वा तद्वटिकाः पश्चात् छायायां शोषयेत्ततः ॥  
 कोष्ठगेनाग्निना<sup>4</sup> पश्चादभिदुभस्त्राद्वयानिलैः ।  
 सत्त्वं पतत्यसंदेहं स्थिररङ्गं दृढं बहु ॥  
 एकमासं द्विमासं वा रसकं खेदितं यदि ।  
 न धातुस्थं तच्च कोष्ठे धमेत्तत् नाल-पथा ॥

\* इति सम्पादितो मार्गो द्वितीयां पातने स्फुटः ।

साक्षादनुभवेर्दृष्टो न श्रुतो गुरुदर्शितः ॥

(1) कृत्वा भाण्डेन सजले is the reading of the text, which is incorrect.

(2) The text reads खल्लमध्ये.

(3) The text has जीरका, which is grammatically incorrect.

(4) The text reads कोष्ठकेनाग्निना, which is not correct.

लोकानामुपकाराय एतत् सर्वं निवेदितम् ।

सर्वेषां चैव लोहानां द्रावणं परिकीर्तितम् ॥

इति श्रीरसराजलक्ष्मी रसकल्पे उमासहस्ररसंवा

सर्वलोहद्रुतिपातनाधिकारः समाप्तः<sup>1</sup> ॥

Extracts from

## RASARAJALAKSHMI.

विष्णुदेवविरचितायाः रसराजलक्ष्म्याः

प्रारम्भः —

यस्येष्टाङ्गुरवल्ली मुकुलिता नानाकलाकौतुकैः

चातुर्थ्येकविलोपलवती कीर्तिप्रसूनप्रसूः ।

(1) समाप्तं शुभम् is the reading of the text, which is not correct.

संनिर्वापयति ज्वरत्रयमहो च्छायाकलापैर्नृणां  
सोऽयं पातु विचारमूर्तिरखिलं कालापलीढं जगत् ॥ १ ॥

जयति दुरितसर्पस्तंडमंभोद्यदर्पः

प्रबलगदविनाशः सेविविध्वस्तनाशः ।

शिव इव विज(वोज ?)मंत्रः संहितायोगमंत्रः

त्रिपुरहरतनूजस्तजसः कायपुंजः ॥ २ ॥

इति श्रीपण्डितमहादेवतनयश्रीविष्णुदेवविरचितायां

रसराजलक्ष्म्यामुल्लासः प्रथमः ॥

दृष्ट्वेमं रससागरं शिवकृतं श्रीकाकचण्डेश्वरी-  
तन्त्रं सूतमहोदधिं रससुधान्धोधिं भवानीमतम् ।

व्याडिं सुश्रुतसूत्रमीशहृदयं स्वच्छंदशक्त्यागमं  
श्रीदामोदरवासुदेवभगवद्गोविन्दनागार्जुनान् ॥

प्रथमः उल्लासः ।

स्वच्छंदशक्त्यागमसारभूतः

समुद्भूतो विष्णुभिषग्वरेण ॥ ११० ॥

द्वितीयः उल्लासः ।

‘आलोक्य सुश्रुतं वृन्दहारीतचरकादिकान् ।

आचयेयं वाग्भटं सिद्धसारं दामोदरं गुरुम् ॥

तृतीयः उक्तासः । \*

\* Foll. 1—43. Linn. 10. Rasarājalakshmīś, de medicamentis metallorum et fossilium ope conficiendis liber. a Rāmeśvara (bhāṭṭa), Viṣṇus filio, compositus. Incipit : आनन्देकरसे विकल्पकल्पनागिमुक्तबीधात्मकिं प्रागत्यावधिसंगतिव्यपगतं etc. ॥ १ ॥ स्वस्तिमुखीमयनमंथनेन (l. स्वस्तिमुखी) sphurad Rasān-bhōdhi gabbhīragarbhāt । śrī-Viṣṇudevi (o devi) labhate pravatnāt śrī Viṣṇuvatsāśī Rasarājalakshmīm ॥ 2 ॥ Dīśi-tvemum Rasasāḡgaram, Śivakṛitam śrī-Karkachandēyari-tantram, Sūtamahodadhiṃ, Rasasudhāmbhōdhiṃ, Bhavānī-matam, Vyāḡī[m], Suśrutasūtram, Īṣahṛidayam, Svach-chandaśaktyāḡgamam, śrī-Dāmodara Vāsūdeva-bhagavad-govinda-Nāḡārjunān ॥ 3 ॥ आनन्दमानन्दकरं प्रसन्नं ज्ञानस्वरूपं निजभाव-युक्तम् । योगीन्द्रमौख्यं भवयोगवैद्यं श्रीमद्गुरुं नित्यमहं नमामि ॥ ४ ॥

महारसाः स्युतवादावष्टौ पारदहिंगुलि ।

वैष्णवसुखकं शैलं चपलं रसकीमलम् ॥ ५ ॥

अभक्तं तुष्टकं (tutthakam) कांतं राजावर्णमघांजनं ।

वद्वक्त्रैकांतकं (o vaikrāntakam) वेति टंकणं च रसान्विदुः ॥ ६ ॥

तालकं गंधकशिले चितिलेखचरगैरिकाः ।

इत्यादयश्चोपरसाः पूर्वाचार्यैरुदीरिताः ॥ ७ ॥

Aufrecht's "Catalogus," p. 321, No. 761.

Colophon at the end of the Rasarájalakshmi—

राजन् (सग्न)शार्वरिवत्सराद्यदिवसे वारे हिमांशोरिदं  
चंचदंभूतलपत्तने विजयिनि श्रीबृहस्पत्योपतेः ।  
शास्त्रं वैद्यकसाररूपमकरोत् श्रीविष्णुदेवः कङ्किः  
वाग्देवोच्चरणारविन्दमकरंदामोदसौरस्यवाक् ॥

Extracts from

## RASANAKSHATRAMALIKA.

मथनसिंहविद्याचैतायाः रसनक्षत्रमालिकायाः

उद्धृताः श्लोकाः ।

चतुश्चतुःशंखकपर्दिकानां

सतक्रजम्बीरविमर्हितानाम् ।

आफेनमाधोकाविषयानां

पलं पलं दन्तिफलाः ॥ २५ ॥

\*यतभस्मगन्धसूता हितयं वक्त्रस्य शुद्धतौष्यस्य ।  
 दग्धा मृगस्य मृङ्गं त्रिगुणं दत्त्वा रसार्धविषम् ॥ १२३ ॥  
 चित्रकशोतशिवावृषदशमूलदिवनदविस्वगिरैः ।  
 कलहत्तारविकृतकैः प्रत्येकं भावनचितयम् ॥ १२४ ॥  
 दत्त्वा सुसिद्धमात्रो मारिचधूपेन धूपितः सम्यक् ।  
 स्वच्छन्दभैरवाख्यो रसः समस्तामयध्वंसी ॥ १२५ ॥  
 त्रिकटुकरसेन युक्तो विशेषतः सन्निपातहरः ।  
 ग्रहणिगदामयशूलव्रणविद्रधिवातगुल्मजयी ॥ १२६ ॥  
 इति स्वच्छन्दभैरवो रसः ॥\*

इयं मालविभूपालभिषजा भिषजां मता ।  
 कृता मधनसिंहेन रसनक्षत्रमालिका ॥ १४२ ॥

इति रसनक्षत्रमालिका समाप्ता ॥ स्वस्ति  
 संवत् १५५७ आश्विन कृष्ण ५ सीमे ।

\* The स्वच्छन्दभैरव रस mentioned in the रसनक्षत्र-  
 मालिका is quite distinct from that, which is stated in the  
 रसिन्द्रचिन्तामणि. Neither has it any analogy with what is  
 described in the रसरत्नसमुच्चय.

Extracts from  
**RASARATNAKARA.**

नित्यनाथविरचितात् रसरत्नाकरत्  
उद्धताः श्लोकाः ।

यदुक्तं शम्भुना पूर्व्वे रसखण्ड रसाणव ।  
रसस्य वन्दनार्थं च दीपिकारसमङ्गले ॥  
व्याधितानां हितार्थाय प्रोक्तं नागार्जुनेन यत् ।  
उक्तं चर्पटिसिद्धेन<sup>१</sup> स्वर्गवैद्यकपालिके ।  
अनेकरसशास्त्रेषु संहितास्वागमेषु च ।  
यदुक्तं वाभटे तन्मे सुश्रुते वैद्यसागरे ॥  
अन्यैश्च बहुभिः सिद्धैः यदुक्तञ्च विलोक्य तत् ।  
तत्र यद्यदसार्थं स्याद्यद्यदुदुर्लभमौषधम् ।  
तत्तत् सर्व्वं परित्यज्य सारभूतं समुद्धृतम् ॥  
क्वचिच्छास्त्रे क्रिया नास्ति क्रमश्चापि न च क्वचित् ।

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(१) धूर्जटिसिद्धेन is the reading in the Sanskrit college

मात्रायुक्तिः क्वचिन्नास्ति सम्प्रदायो न च क्वचित् ।  
 तेन सिद्धिर्न तत्रास्ति रसे वाथ रसायने ॥  
 वैद्ये वादे प्रयोगे च तस्माद्यत्नो मया कृतः ॥  
 यद्यदगुरुमुखाज्ज्ञातं स्वानुभूतञ्च यन्मया ।  
 तत्तल्लोकहितार्थाय प्रकटीक्रियतेऽधुना ॥

प्रथमोपदेशे ।

इति श्रीपार्व्वतोपुन्ननित्यनाथसिद्धविरचिते रसरत्नाकरे  
 रसखण्डे रसपीठिका नाम प्रथमोपदेशः ।

परीक्षा भारिते सूते कर्त्तव्या च यथोदिता ।  
 अधस्तुषाग्निना तप्तो ह्यक्षोणस्तिष्ठते यदा ।  
 तदा भस्म विजानीयाच्चक्षुषां यामं निरीक्षयेत् ॥  
 तृतीयोपदेशे ।

दन्ते शृङ्गेऽथवा वंशे रक्षयेत् साधितं रसम् ॥  
 चतुर्थोपदेशे ।

अथातः शुद्धसूतस्य मूर्च्छनाविधिरुच्यते ।  
 मेघनादावचाहिङ्गशूरणैर्मर्दयेद्रसम् ॥

नष्टपिष्टन्तु तद्गोलं हिङ्गुना वेष्टयेद्वहिः ।  
 पचेत्तवण्यग्नस्थं दिनैकां चत्वारिंशत् ।  
 जर्द्वलम्नं समादाय दृढं वस्त्रेण बन्धयेत् ।  
 जर्द्वधो गन्धकं तुल्यं दत्त्वा सीमानले पचेत् ॥  
 जीर्णे गन्धे पुनर्देयं षड्भिर्वारैः समं समम् ।  
 षड्गुणे गन्धके जीर्णे मूर्च्छितो रोगहा भवेत् ॥  
 चतुर्थोपदेशे ।

Extracts from

## DHATURATNAMALA.

धातुरः मालायाः

प्रारम्भः—

प्रणम्य वितर्ती शक्तिं त्रिसृष्ट्युत्पत्तिकारिणीं ।  
 धातूनां रत्नमालायामभिधायं करोम्यहं ॥ १ ॥  
 ब्रह्मविष्णुहराद्यान् ये मर्त्ता ध्यायन्ति नित्यशः ।  
 ज्ञानदानप्रदानाय सा मे विश्वेश्वरी मता ॥ २ ॥

अथ धातूनां रत्नमालां वक्ष्यामि ।

रौप्यं हेमं तथा ताम्रं नागं वंगं तक्षायसं ।

स्वर्पराभ्रकमौक्तं च प्रवालं तालकं शिला ॥ २ ॥

सुवर्णमाक्षिकं सूतं हीरकं च ब्रवीम्यहं ।

सर्वधातूपधातूनां लक्षणं मारणं गुणं ॥ ४ ॥

अथ रौप्यमारणं ।

रौप्यं शुद्धं समादाय नागेन गुरु शोधयेत् ।

शुद्धे तारे पुनः पश्चात् दक्षपत्राणं कारयेत् ॥ ५ ॥

निंबचिंचिणिद्राक्षाभिः शोधयेच्च पृथक् पृथक् ।

ज्वालयेद्दुदकैः सार्वं तथा दुग्धेन शोधयेत् ॥ ६ ॥

गंधपारदयोरैक्यं किंचिद्वंगं च चर्षयेत् ।

द्राक्षाया द्रवसंयुक्तं तारपत्राणि शोधयेत् ॥ ७ ॥

चक्रयन्त्रे विनिक्षिप्य लेपयेद्दन्तद्वाराणां ।

क्षिपेद्गजपुटे गर्ते ज्वालयेद्बहुक्षणाकान् ॥ ८ ॥

समाप्तिः—

ग्रंथो वैष्णवनामायं रसासेवांतसागरात् ।

धातूनां रत्नमाला च ततो वैद्यस्य हितवे ॥ १७६ ॥

मरणेभ्यो भयत्रस्ता रोगग्रस्ताश्च ये नराः ।

रत्नमाला कृता तेषां वैद्यानां च हिताय वै ॥१७७॥

इति श्रीवैद्यकशास्त्रे अश्विनीकुमारसंहितायां

धातुरत्नमालायां समाप्तोऽयं ग्रंथः ॥

The following is taken from Aufrecht's "Catalogus"—No. 760.

Incipit :—प्रणम्य सारदां शक्तिं सृष्टेरुत्पत्ति-  
कारकां । धातूनां रत्नमालां च विबोधाय करोम्यहं  
॥१॥ ब्रह्माविष्णुहरान् ध्यायेद्भक्ता ध्यायन्ति नित्यशः ।  
तेषां वरप्रदानाच्च सा मयैवमुदीर्यते ॥ २ ॥ रूप्यं  
हेम तथा ताम्रं नागं वंगं तथायसं । स्वर्परे गगनं  
प्रोक्तं प्रज्वालं तालकं शिला ॥ ३ ॥ मात्तिकं गंधकं  
सूतं हीरकं च ब्रवीम्यहं । सर्वधातूपधातूनां लक्षणं  
मारणं गणान् ॥ ४ ॥ रूप्यं शुद्धं समानीय नाग-  
मूषा नु शोधयेत् । शुद्धे तारे पुनः पश्चात् सूक्ष्म-  
पत्राणि कारयेत् ॥ ५ ॥ निंबुचिंचिणीद्राक्षाभिः शोधनीयं  
पृथक् पृथक् । चालयेदुदकैः सार्द्धं तथा दुग्धेन  
शोधयेत् ॥ ६ ॥ गंधकं पारदं रूप्यं किंचिद्वंगं च

घर्षयेत् । द्राक्षारसेन संयुक्तं तारपत्राणि लेपयेत्  
॥ ७ ॥ नक्तं यन्त्रे विनिश्चिप्य लेपयेद्वस्त्रमृत्तिकां ।  
क्षेयं गजपटे गर्ते ज्वालयेश्च ग्रहोपलैः ॥ ८ ॥

In fine libelli disticha haec leguntur :

ग्रंथो वैद्य[क]नामायं Rasasiddhāntas īgarāt ।

धातूनां रत्नमाला च कृता वैद्यसुहेतवे ॥ १ ॥

मरणेभ्यो भयत्रस्ता रोमग्रस्ताश्च ये नराः ।

रत्नमाला हि धातूनां कृता तेषां हिताय वै ॥ २ ॥

Jatya Gurjarakhaṇḍas cha, Devadatto

hi dharmavit ।

Harer nāmābhīchānasya सुतस्तस्य भिषग्वरः ॥ ३ ॥

मंहितारसकर्माणि यस्य बुद्धिर्गरोयसी ।

तं न शास्त्रविधिज्ञेन कृता रत्नस्य मालिका ॥ ४ ॥

इति देवदत्तकृतवैद्यकशास्त्रे धातुरत्नमाला ॥

Extracts from

## RASAPRADIPA.

रसप्रदीपादुद्धृताः श्लोकाः ।

A—MS. from Alahabad.

B—MS. from Benares.

अथ शङ्खद्रावरसः ।

स्फटिका<sup>1</sup> नवसारस सुश्लेता<sup>2</sup> च सुवर्चिका ।

पृथक् दशपलोद्भूतं गन्धकः पितुसंमितः<sup>3</sup> ॥

चूर्णयित्वा क्षिपेद्वाण्डे मृन्मये मृद्विलेपिते<sup>4</sup> ।

तन्मुखं मुद्रयेत् सम्यक् मृदभाण्डेनापरिण च ॥

सरन्ध्रोदरकेणैव पुष्पां तिर्यक् च धारयेत् ।

अधः प्रज्वालयेद्दङ्गिं हठाद्यावद्रसः स्रवेत् ॥

(1) A reads स्फटिका. B reads स्फुटिका.

(2) B reads सुश्लेता, which is not correct.

(3) B reads पितुसंमिषुतः, which is not correct.

(4) मृद्वि लेपिते is the reading in B.

शार्णैकं सेवयेद्यन्नात्<sup>1</sup> दन्तस्पर्शविवर्जितम् ।  
 शुक्लोदरयुक्तत्प्रीहयन्विषयान्नादिशूलगु<sup>2</sup> ॥  
 बलपुष्टिप्रदो श्लेष भुक्तं च आरयेत् क्षणात् ।  
 विलोक्यतां महालोका रसमा<sup>3</sup> । अममृतम् ।  
 कपर्दकाश्च लोहानां यस्मिन् क्षिप्ता<sup>4</sup> यस्मिन् हि ॥

फिरङ्गव्याधिः—

गैरिकं रसकर्पूरम् उपला च पृथक् पृथक् ।  
 टङ्कमाणं विनिष्पिष्य<sup>5</sup> ताम्बूलीदलजैः रसैः ॥  
 वत्स्यचतुर्दशस्त्रेषां<sup>6</sup> कर्त्तव्या भिषगुत्तमैः<sup>7</sup> ।  
 सायं प्रातः समश्नीयात्<sup>8</sup> एकैकां दिनसप्तकम्<sup>9</sup> ॥

(1) B reads यस्तु.

(2) A reads क्षिप्ता.

(3) A reads विनिःस्पिष्य.

(4) A reads चतुर्दशस्त्रेषां. B reads चतुर्दशस्त्रेषां.

(5) B reads श्लेषगौतमी, which is incorrect.

(6) B reads समश्नीयात्, which is incorrect.

(7) दिनसप्तकं, an incorrect variant in B.

सष्टता योलिका<sup>1</sup> देया भोजनार्थं निरन्तरम् ।

फिरङ्गव्याधिनाशाय वटिकेयमनुत्तमा ॥ \*

(1) गोधूमरोटिका इत्यर्थः-

\* The following is taken from योगतरङ्गिणी of Tri-mallabhatta, printed in Bombay in the Saka year 1810.

यंचे सुसिद्धे डमरुसमाख्ये  
निधाय सूतस्य पत्तानि पंच ।  
बन्ध्नीकमुत्सृज्य खटिकेष्टिकानां  
सर्गैरिकाणां तुवरौयुतानाम् ॥ ६० ॥  
ससंधवानां समभागिकानां  
चूर्णादिकं चोपरितो निदध्यात् ।  
अस्त्रेण दध्ना महिषीभवेन  
पिष्टं रसीनस्य शरावमेकम् ॥ ६१ ॥  
समक्रमेणात्र निधाय खंडै-  
राच्छादयेत् खर्परजैर्विसंधि ।  
चूर्णप्रलिप्तोदरमूर्ध्वभांडं  
संस्थाप्य संमुद्रा दृढं सुचुल्लगाम् ॥ ६२ ॥  
प्रज्वालयेद्भस्मिन् क्रमेण  
संस्थाप्य यंचोपरि वस्त्रमार्द्रम् ।  
वज्रं प्रदद्याद्दिनषट्कमत्र  
तत् स्वाकृष्टीतं परिगृह्य बुद्ध्या ॥ ६३ ॥

चन्द्रोदयाख्यरसवर्णने—

काशे श्वासे फिरङ्गाख्ये रोगे च परमो हितः ।

अथ उपायान्तरम्—

मुशल्या<sup>१</sup> कुलकञ्चैव<sup>२</sup> पारसीकयमानिका ।

भस्मातकफलं चापि प्लुतमानं पृथक् पृथक् ॥

तं द्रोणपुष्पोपयसा प्रपिष्टं

कृष्यां विदध्यान्न वसादरं च ।

कर्षप्रमाणं प्रहरत्रयं च

वक्त्रं प्रदद्यादथ शीतलांगीम् ॥ ६४ ॥

निष्कास्य कृपीं सिकतास्त्रायञ्चा-

दास्फोद्य कंठस्थमसुं प्रगृह्णात् ।

कर्पूरनामा रसनायकाऽयं

वज्रः पुराणेन गुडेन भुक्तः ॥ ६५ ॥

निर्वृताभाजा सकृज्जा च पथ्य-

शीलेन कुष्ठामयनाशनः स्यात् ॥

फिरङ्गकरिकेशरी सकलकुष्ठकालान्मो-

ऽखिलद्रव्यविनाशकद्रवणजगर्षपृतिप्रदः ।

सुवर्णसमवर्णकृद्बलहताशतेजस्करः

समलगदतस्कारो रसपतिः न कर्पूरकः ॥ ६६ ॥

इति कर्पूररसः बौद्धसम्बद्धात् ।

(1) B reads मुशल्या.

(2) B reads कलकं चैव.

पलाईमानः सूतः स्यात् षट्पक्षोऽत्र गुडः स्मृतः ।  
 एकांक्षत्वात् खं कुर्यात् वटीः कर्षप्रमाणतः ॥  
 खादेदेकां वटीं प्रातर्यावदारोग्यदर्शनम् ।  
 गोदध्नद्यानुपानेन फिरङ्गमयनाशिनी<sup>1</sup> ॥  
 निम्बुकेन<sup>2</sup> विना नैव वर्जनीयमिहापरम् ॥

अथ उपायान्तरम्—

चोपचीनीभवं चूर्णं शाणमानं समाक्षिकम् ॥  
 फिरङ्गव्याधिनाशाय भक्षयेत्तद्वर्णं त्यजेत् ॥

(1) B reads फिरङ्गापविनाशिनी.

(2) B reads निम्बुकेन.

Extracts from  
**DHATUKRIYĀ or**  
**DHATUMANJARI.**

रुद्रयामले धातुक्रिया धातुमञ्जरी वा ।\*

श्रीगणेशाय नमः ।

पाञ्चत्युवाच ।

अथानन्तरं<sup>१</sup> देवेश ब्रूहि धातुसुसंस्कृतिम्<sup>२</sup> ।

येन विज्ञानमात्रेण साधयेद्धातुसंज्ञितः ॥ १ ॥

महादेव उवाच ।

धातुसुर्थविधः प्रोक्तः सुर्थसुर्थे स्वपक्षतः<sup>(१)</sup><sup>३</sup> ।

सत्त्वं रजस्तमसैव चतुर्थसु निरामयः ॥ २ ॥

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\* The Ulwar MS. (A) reads धातुक्रिया, a part of the Rudraya'mala ; but the Benares MS. (B) reads धातुमञ्जरी, a part of the same. The two MSS. are exactly the same in subject matter, differing only in name.

(1) A reads अथानन्तर, which is grammatically incorrect.

(2) A reads धातुसु संस्कृति, which is grossly incorrect.

(3) The sense here is not clear.

राजसे राजसी सिद्धिस्तामसे तामसी सदा ।

सत्त्वसाधनं सात्त्विक्ये आनीते<sup>1</sup> सर्वसाधनम् ॥ ३ ॥

पार्वत्युवाच ।

कथ्यतां देवदेवेश सत्त्वं राजसतामसम् ।

अतीव गुणवत्<sup>2</sup> धातोः कार्यं लक्षणलक्षितम्<sup>3</sup> ॥ ४ ॥

उपधातुक्रमेणैव तेषां लक्षणसाधनम् ।

विटकी च मुदा युक्ता तेषां कर्मसु<sup>4</sup> साधनम् ॥ ५ ॥

उपकारो<sup>5</sup> गुणलक्षं नाना कार्यक्रिया शुभा ।

वियोगयोगचाञ्चल्यं वर्णभेदैस्तु मारणम् ॥ ६ ॥

समग्रं देवदेवेश विशेषा धातुकृतक्रियाः ।

येन विज्ञानमात्रेण साधयेत् गन्धकीः क्रियाः ॥ ७ ॥

3

(1) A reads अनीते, which seems to be incorrect.

(2) A has गुणवती, which appears to be incorrect.

(3) 'कार्यं लक्षणलक्षितम्', a variant in A, which is not correct.

(4) A reads erroneously कर्मसु.

(5) A reads उपकारं, which is grammatically incorrect.

महादेव उवाच ।

पृथिव्या गर्भमध्ये तु अनेका धातुः स्थितिः<sup>१</sup> ।

विस्तृता<sup>२</sup> कियत्कालेन धातुर्नानाविधोदिता<sup>३</sup> ॥८॥

गुणलक्षणसंयुक्तां<sup>४</sup> साम्प्रतं न स्मरामि ह<sup>५</sup> ॥

कथं ते कथयिष्यामि<sup>६</sup> वद ब्रह्माण्डवासिनि ॥ ९ ॥

पार्वत्युवाच ।

ये केचित् स्मरन्त<sup>७</sup> ईश व्यक्तं कथय साम्प्रतम् ।

भवतो<sup>८</sup>ऽनुग्रहेणैव साधनार्थं<sup>९</sup> सिध्यति ॥ १० ॥

(1) अनेका धातु तिष्ठति, a variant in A, which treats the word धातु in the masculine as well as in the feminine genders.

(2) A reads विस्तृता, which is not correct.

(3) धातुर्नानाविधोदिता, an incorrect variant in A.

(4) A reads संयुक्ता, which is grammatically incorrect.

(5) A reads स्मरति ह, which is incorrect.

(6) कथयामास is the incorrect reading in A.

(7) A and B read स्मरते, which is grammatically incorrect.

(8) भवता is the reading in A and B, which is not correct.

(9) साधनार्थं is the incorrect reading in A and B.

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुं नानाविधस्थितिम् ।

गुणलक्षणसंयुक्तां यथा बुद्धिः<sup>१</sup> कथिष्यति ॥ ११ ॥

सुख्यप्राधान्यता<sup>२</sup> एते रङ्गलोहक<sup>३</sup>ताम्रकैः ।

रजतेनैव<sup>४</sup> संयुक्ता धातोरुत्तमता सदा ॥ १२ ॥

मध्यमा सत्त्वजा धातुः<sup>५</sup> नीचा च अपुसीसयोः ।

संयोगे धातुनामा हि नीचा नीचतरा स्मृता ॥ १३ ॥

संयोगान्ते त्रिधा प्रोक्ता उत्तमा मध्यमाधमा ।

ताम्रजासत्त्वयोर्योगे<sup>६</sup> नारीधातुः प्रजायते ॥ १४ ॥

(1) A and B read बुद्ध्या.

(2) सुख्यप्राधान्यता is the correct reading. प्राधान्यता is grammatically incorrect.

(3) A and B have रङ्गलोलोहकैः, which mars the metre.

(4) A reads रजतेनैव, which is not correct.

(5) धातुः is used here in the feminine gender both by A and B.

(6) Vide verse 20.

एषा<sup>१</sup> मध्योत्तमा प्रोक्ता कार्यकारणयोगके ।  
 अपुताम्नसंयोगेन<sup>२</sup> जाता धातुष्व मध्यमा ॥ १५ ॥  
 सीसके<sup>३</sup> भङ्गदा प्रोक्ता कार्यकाले सदीदिता ।  
 अनेनैव प्रकारेण येन येन च कर्मसु ॥ १६ ॥  
 कर्त्तव्या जाघवी विद्या ज्ञात्वा<sup>४</sup> बुद्धिविशारदैः ।  
 अभङ्गं सीसके जातं शुद्ध उत्पत्त्यकारकम् ॥ १७ ॥  
 हाटके श्वेतता जातेः<sup>५</sup> अक्षया<sup>६</sup> रजते यदि ।  
 लघुद्रावः शुभे शुल्के लोहे च द्राविणी कला ॥ १८ ॥

(1) Both A and B read एतत्, which is grammatically incorrect.

(2) संयोगे is the reading in A and B, which mars the metre.

(3) A and B reads सीसके.

(4) A reads ज्ञात्वा, which is incorrect.

(5) A and B read जाते, which is incorrect.

(6) A reads अक्षयी. B reads अक्षनी. Both the readings seem to be incorrect.

जासत्वे अङ्गहीना च काठिन्याभ्यधिकौ परौ ।  
 कला एताश्च धातूनां जातेर्भवति शुद्धता<sup>१</sup> ॥ १८ ॥  
 कला एतादृशी दिव्याः प्राप्तः<sup>२</sup> सिद्धसु जायते ।  
 एवञ्जासत्वसंयोगे नारीधातुसु<sup>३</sup> जायते ॥ २० ॥  
 कार्यानि ककरो प्रोक्ता पाचामोदसु<sup>४</sup> कोमला ।  
 मारणे जारणे दिव्या चारणे चोटने तथा ॥ २१ ॥  
 निर्गन्धा वर्णरहिता जातिभेदकरी स्मृता<sup>५</sup> ।  
 एतावद्<sup>६</sup> गुणसंयुक्ता कार्यकारणसंयुता ॥ २२ ॥

(1) जाते भवति शुद्धताः, a variant in A. जाते भवति रशुद्धताः, an incorrect variant in B.

(2) A and B read प्राप्ते, which is grammatically incorrect. ३

(3) A reads नारीधन्यवसु. B reads नारीधन्यवसु. Both seem to be incorrect. (Vide verse 14.)

(4) B reads पाचामोदसु, which is unintelligible.

(5) A reads मता.

(6) Both A and B read एतद्, which destroys the metre.

संस्कारैः संस्कृता सर्वैः<sup>1</sup> सर्वसिद्धिकरी कृता ।  
 नानासुवर्णकार्येषु रूप्यकार्यैः संयुता ॥ २३ ॥  
 धातुधौता च या<sup>2</sup> धातुः सुधामायः संस्कृता ।  
 कार्यसिद्धिकरी<sup>3</sup> श्रेष्ठा ज्येष्ठकार्यविधायिका<sup>4</sup> ॥ २४ ॥  
 सर्वथाशु सुधामायः<sup>5</sup> आसयहणया । कः(?) ।  
 ग्राहयेत् आसमात्रेण पाचयेद्दशनं<sup>6</sup> स्त्रियम् ॥ २५ ॥  
 स्वर्कायाग्रनसंपत्ते<sup>7</sup> जाते भवति सिद्धिदा ।  
 अन्यथा नैव सिध्यन्ति जायते मृग-अम्बुवत् ॥ २६ ॥

(1) A and B want सर्वैः, thus rendering the foot incomplete.

(2) A and B read धे, which is not correct.

(3) कार्यसिद्धिकरी is the variant in A and B.

(4) A and B read विधायिका, which is grammatically incorrect.

(5) A has an incomplete foot सर्वतेसुधा B also has । सर्वो तेसुधा.

(6) A reads पाचयेत् दशन. B reads पाचयेत् दशनं. Both of them seem to be incorrect.

(7) B reads संयुक्ते.

तस्मात्तेनैव यत्नेन सुधामायः<sup>१</sup> सुसंस्कृतिः ।

यथोक्तसंस्कृतियुता<sup>२</sup> सर्वतो धातुरुत्तमा<sup>३</sup> ॥ २७ ॥

क्रियोचितसुसंस्कारान्<sup>४</sup> कारयेद्यत्नतः सदा ।

यथोदितैस्तु संस्कारैर्युक्ता कार्यकारौ सदा ॥ २८ ॥

सर्वसंस्कारसंज्ञा धातुधीता सदैव हि ।

जायते नैव सन्देहः कार्यकारणकारिका<sup>५</sup> ॥ २९ ॥

पार्ष्वत्युवाच ।

कियत्परिमिता धातुः संस्था षट्सु मे विभो ।

उत्पत्तिर्लक्षणं तेषां स्थानं चैव<sup>६</sup> पृथक् पृथक् ॥ ३० ॥

(1) A reads सुधाभाय. B reads सुधाभाय. Both are unintelligible.

(2) Both A and B read संयुक्ता, which mars the metre.

(3) सर्वतो धातुरुत्तमा, a variant in A and B, which is grammatically incorrect.

(4) A and B read only संस्कारा, which is incorrect.

(5) Both A and B read कारका, which seems to be incorrect.

(6) B reads स्थानं तेषां.

कथ्यतां देवदेवेश लक्ष्यलक्षणसंस्कृतिः ।

भेदोऽभेदोऽयं<sup>१</sup> योगश्च सारणं चारणं तथा ॥ ३१ ॥

पातनं द्रावणं चैव ऋटनं जारणं तथा ।

सारणं जीवनं षष्ठं गोपनं लेपनं पुनः<sup>२</sup> ॥ ३२ ॥

जातिभेदः सुगन्धश्च मेलनं जरणं परम् ।

समग्रं कथ्यतां देव उपधातुकरी क्रिया ॥ ३३ ॥

महादेव उवाच ।

शृणु देवि प्रवक्ष्यामि धातुस्थानानि लक्षणम् ।

उपधातुरनेका द्वि<sup>३</sup> तेषां सारणचारणम् ॥ ३४ ॥

अक्षयं राग(?)<sup>४</sup>कारं च शोधनं बन्धनं तथा ।

सारणादि च यत् प्रोक्तं तत् सर्वं श्रूयतां शुभे<sup>५</sup> ॥ ३५ ॥

(1) भेदभेदश्च is the incorrect reading in A and B.

(2) A reads पुनः, which is senseless.

(3) उपधातुरनेकानि, an incorrect variant in A and B.

(4) Both A and B want this word, which may be supposed to be राग or बल here.

(5) तत् सर्वं कथयामि ते, a variant in A.

पार्वत्युवाच ।

प्रथमं वद देवेश धात्वनुक्रमलक्षणम् ।

प्रत्येकस्थानरूपं हि गुणसम्बन्धकारकम् ॥ ३६ ॥

महादेव उवाच ।

शृणु देवि प्रयत्नेन सिद्धान्तवचनं मम ।

येन विज्ञानमात्रेण जायते धातुकृतक्रिया ॥ ३७ ॥

प्रथमे धातुनामानि संक्षेपात् कार्यकारणम् ।

कथयामि च ते भद्रे पश्चात् स्थानस्य संपदः<sup>१</sup> ॥ ३८ ॥

षादौ सुवर्णनामानि संक्षेपात् शृणुतां प्रिये ।

स्वर्णं सुवर्णं सूर्यश्च हाटकं वज्जिरोचनम् ॥ ३९ ॥

सु(स)रङ्गं च तथा लोहं देवधातुर्मनोहरम् ।

वेशी<sup>२</sup> विष्णासगं चैव धर्मदं क्षपिदेवता ॥ ४० ॥

जीवनम् असृतं चैव हेमं<sup>३</sup> हिमवतोद्भवम्<sup>४</sup> ।

देववज्रभगं दिव्यं संसारोत्तारणं महत् ॥ ४१ ॥

(1) Both A and B read संपदि, which has no sense.

(2) A reads वशी.

(3) हेम is generally used.

(4) हिमवदुद्भवं is the correct term. .

जीवनं सर्वलोकानां<sup>1</sup> नारीणां रक्षणं शुभम् ।  
 अन्यानि विविधानामानि<sup>2</sup> गोप्यगोप्यतराणि च<sup>3</sup> ॥ ४२ ॥  
 रजतं च तथा रूप्यं चन्द्रस्य च दीपकम् ।  
 शुभ्रज्योतिकरं<sup>4</sup> स्वर्णेषद्वीजं तारकं तथा ॥ ४३ ॥  
 अनन्ता वर्तते तेषां कथा वृद्धिकराश्च ये ।  
 स्थापितं लौकिकं चैव<sup>5</sup> येनाग्रन्यसमूहनम् ॥ ४४ ॥  
 शीतवीर्यं लघुवीर्यं विषघ्नं वातनाशनम् ।  
 रसपुञ्जोकरं श्रीदं धातुपुञ्जनकारकम् ॥ ४५ ॥

(1) The first term in the previous verse is only जीवनं. But here it is सर्वलोकजीवनं. Hence there is no repetition.

(2) अन्यानि विविधान् नामान्, an incorrect variant in A and B.

(3) गोप्यागोप्यतराणि च is the reading in A and B, which has no clear sense.

(4) A and B read शुभ्रज्योतिकरं, which is incorrect.

(5) A reads लौकिका येना, which leaves out चैव.

रतिदं बहुवीर्यं च शुभधाम च संक्षयम् ।

एतानि रजतनामानि शतान्यन्यानि सन्ति वै<sup>1</sup> ॥ ४६ ॥

तान्नं च<sup>2</sup> चाम्बकाधिष्ठं शुक्लं नागस्य मर्हन्म् ।

नीलं च नीलविभ्रमं वसनं<sup>3</sup> चैव पातकम् ॥ ४७ ॥

उष्णम् उष्णकरं सिद्धं लज्जकं कालमर्हन्म् ।

हेमगर्भं<sup>4</sup> च कामोदं विषदं विषनाशनम् ॥ ४८ ॥

भारक्षश्च सहायश्च<sup>5</sup> मन्मथो मार एव च ।

एतानि रत्ननामानि चान्यानि विविधानि च ॥ ४९ ॥

जासत्वं च जरातीतं राजतं यशदायकम् ।

रूप्यभ्राता वरीयश्च चोटकं कीमलं लघु ॥ ५० ॥

(1) A has शतान्यानि वर्तते. B has रजतानानि वर्तते. \* Both the readings are grammatically incorrect.

(2) च is dropped in A and B.

(3) The sense of नीलविभ्रमं seems to be नीलविभ्रमं = नीलशीमम्. A reads चमनं, which is incorrect.

(4) A reads हेमगर्भं...

(5) A and B read सहायं च.

चर्मकं खर्परं चैव रसकं रसवर्धकम्<sup>१</sup> ।

सदापथ्यं बलोपेतं पीतरागं सुभक्षकम् ॥ ५१ ॥

एतत्सु<sup>२</sup> खर्परनाम कार्यकर्मसु सिद्धिदं<sup>३</sup> ।

रसराजार्द्रकं कर्म<sup>४</sup> कृतं सिद्धिषु<sup>५</sup> जायते ॥ ५२ ॥

चपुस्तापहरं वङ्गं रजतारिख<sup>६</sup> नीरदम् ।

शीतवीर्यकरं त्रीदं रतिदं तापहारकम् ॥ ५३ ॥

(1) रसवर्धकं, the reading in A and B, is not grammatically correct.

(2) तत्ते is the reading in A and B, which is incorrect.

(3) Both A and B read कार्यकर्मसु सिद्धिदान्, which is grammatically incorrect.

(4) रसराजार्द्रकान् कर्मान्, an incorrect variant in A, and B.

(5) A reads कृते सिद्धिषु. B reads कृते सिद्धिषु. Both are incorrect.

(6) Both A and B read रजतारिख, which is senseless here.

मेहघ्नं माह्लाद(?)भूतं सहायं धातुशेषयोः ।  
 एतानि चपुनामानि सुसिद्धं कार्यकारकम्<sup>1</sup> ॥५४॥  
 सौसकं<sup>2</sup> धातुभङ्गं च मृतकं रोचकं परम् ।  
 रक्तं च रक्तवीर्यं<sup>3</sup> च<sup>3</sup> रक्तवत् विवर्धनम् ॥ ५५ ॥  
 अन्तरूप्यं च गम्भीरं धातुभञ्जनकारकम् ।  
 ग्राहकं रसरजिन अक्षीभ्याक्षीभणं परम् ॥ ५६ ॥  
 विचित्रं विनतं चैव नानारङ्गप्रदायकम् ।  
 नागं नगालयं प्रोक्तं सिक्तकं कण्ठशोधनम् ॥ ५७ ॥  
 षण्डं षण्डकरं<sup>4</sup> चैव दुरितं षण्डकारकम् ।  
 एतानि<sup>5</sup> न पालयानि कार्यकाले प्रयोजयेत् ॥५८॥  
 लोहं च आयसं शूरं सूर्यकम्भविधारकम् ।  
 हस्तकं खमनं स्वर्णमारकं<sup>6</sup> ताटकं मलम् ॥ ५९ ॥

(1) सुसिद्धे कार्यकारकान्, an incorrect variant in A and B.

(2) A and B read श्रीशकं.

(3) B has only रक्तं वीर्यं च, which is incomplete.

(4) A reads खड्गं खड्गकरं चैव.

(5) A and B read एतत्ते, which is incorrect.

(6) A has खड्गं प्रारकं. B has खड्गं मारकं.

अजरं च जरायुक्तं धात्वाद्यम् अवनीसुतम् ।  
 कालेयं जीषणं कालं रुधिरं रोगनाशनम् ॥ ६० ॥  
 ग्रन्थिदं सर्वधातूनाम् अक्षोभ्यं जलवज्जिषु ।  
 वज्जिदं वज्जिवोजं च सर्वधातुसहायकम् ॥ ६१ ॥  
 एतानि लोहनामानि ज्ञात्वा कर्माणि कारयेत् ।  
 जायते<sup>१</sup> सकला सिद्धिर्वियोगयोगसंयुता<sup>२</sup> ॥ ६२ ॥  
 नामानि धातुसंयोगे जातानि तानि च शृणु<sup>३</sup> ।  
 शुल्बखर्परसंयोगे जायते पित्तलं शुभम् ॥ ६३ ॥  
 पित्तलं चैव नारीकं कफदं गन्धदुर्जयम् ।  
 वर्णदं दुर्बलं चैव राजतं वज्रभं लघु ॥ ६४ ॥  
 वान्तान्त्रसंयोगेन जायते तेन<sup>४</sup> कांस्यकम् ।  
 कांस्यकं कोमलं चैव नैरसं रसकाठिनम्<sup>५</sup> ॥ ६५ ॥

(1) A reads जायते.

(2) वियोगयोग is the variant in A. विबीगायोग is the variant in B. Both the readings seem to be incorrect.

(3) जातानि च ते शृणु, an incomplete variant in A and B.

(4) A has जातेनैव. B has जायते तेनैव.

(5) A and B read erroneously कठिनं.

तीव्रनादं महाशब्दम्<sup>1</sup> उपकान्ति रवियहम् ।  
 व्याहकं<sup>2</sup> रौद्रं च व्याहकं<sup>3</sup> धूमरोधनम् ॥ ६६ ॥  
 एतानि<sup>3</sup> कार्यकाले प्रयोजयेत् ।  
 बन्धने धारणे चैव मुद्रणे धूमबन्धने ॥ ६७ ॥  
 स्वर्परेः सह पारदं दिव्यं<sup>4</sup> किञ्चित् प्रमेलयेत् ।  
 जायते रसको नाम नानारोगहरो भवेत् ॥ ६८ ॥  
 नागसु रहते<sup>5</sup> होनो मृतधातुसु जायते ।  
 स एव कीमलाग्निस्थः<sup>6</sup> सिन्दूरं जायते ध्रुवम् ॥ ६९ ॥

(1) A reads महाशब्दं. B reads महत्शब्दं. Both the readings are incorrect.

(2) A reads व्याहकं, which has no clear sense.

(3) A and B read एतानि, which is incorrect

(4) पारदो दिव्यो is the reading in A and B, which is incorrect.

(5) B reads रहते, which is not correct.

(6) कीमलाग्निस्थे is the reading in A and B, which is not correct.

अनेकाः<sup>१</sup> साधयेद्विद्या मन्त्रयन्त्रकरोः क्रियाः ।

पूजनार्थं मम गुणाः सर्वे कल्पितरोचनाः<sup>२</sup> ॥ ७० ॥

तान् । हजसैयोगे जायते तुल्यकं शुभम् ।

नाना रसायनी विद्या साधयेत् सा<sup>३</sup> सदैव हि ॥ ७१ ॥

रसरसक(?)<sup>४</sup> योगेषु राजमर्त्यादा जायते ।

राजकं जायते नाम नारी राजकलामतिः<sup>५</sup> ॥ ७२ ॥

संयोगे साधनं दिव्यं वियोगे साधनं शुभम् ।

वियोगं पुनरैर्योगं रसतान्त्रे शुभो विधिः<sup>६</sup> ॥ ७३ ॥

(1) A reads एनेका. B reads एतेका. Both are incorrect.

(2) A and B read कल्पितरोचनं.

(3) सा is not found in A and B.

(4) A and B read रसरसयोगेषु, which is incomplete.

(5) नाराराजकलामतिः, a variant in A. नाराजकलामतिः, a variant in B. Both the readings seem to be incorrect.

(6) A and B read शुभविधिः.

अनेका साधनी विद्या साधयेद्रव्यकाङ्क्षितः<sup>१</sup> ।

लभते रसायनीं विद्यां स्वस्थोऽपि विवृतोद्यमी ॥७४॥

अनेनैव प्रकारेण ज्ञायते नाम कर्मभिः ।

नामकर्मज्ञता<sup>२</sup> जाते चित्ते निर्मलता<sup>३</sup> भवेत् ॥७५॥

एतत्ते कथिता धातोरुपधातोस्तु तां<sup>४</sup> शृणु ।

येन विज्ञानमात्रेण कालकाव्या<sup>५</sup> न लिप्यते ॥ ७६ ॥

उपधातोस्तु मध्येषु श्रेष्ठा माता रसायनी ।

तस्या नामानि वक्ष्यामि पश्चात् स्थानगुणानपि<sup>६</sup> ॥७७॥

(1) A reads द्रव्यकोखितः. B reads द्रव्यकाङ्क्षितः.

(2) A and B read नामकर्मज्ञता, which is unintelligible.

(3) A and B read निर्मलता, which is not grammatically correct.

(4) A and B read ते, which is incorrect.

(5) A reads कालकाव्यू. B reads कालकाव्यू. Both the readings are incorrect.

(6) Both A and B read गुणानि च, which is incorrect.

हरितालं विसङ्गा च रङ्गदीप्तिकरी सदा ।

तालं च हरितम् हंसी श्वेतपीतविधायिनी ॥ ७८ ॥

नर्तकस्य प्रिया देशी निशा चैव निशाचरी ।

पारदस्य क्षयकरी पद्मच्छेदकरी स्मृता<sup>१</sup> ॥ ७९ ॥

रोगहा जीविनी जेनी जरादारिद्र्यनाशिनी ।

एतानि तालनामानि संक्षेपात् कथितानि ते<sup>२</sup> ॥ ८० ॥

युक्तो ज्ञानेन यः<sup>३</sup> कर्त्ता अक्षोभ्यो<sup>४</sup> जायते सदा ।

अनेनैव प्रकारेण कर्त्ता कर्माणि साधयेत् ॥ ८१ ॥

मनःशिला शिला शृङ्गी कुनटी च कृतोद्यमा ।

दरदा<sup>५</sup> भगिनी देशी सिन्दूरस्य सखी सदा ॥ ८२ ॥

(1) The 78th and 79th slokas are not found in A.

(2) संक्षेपे विकथानिजे, a variant in A and B, which has no sense.

(3) युक्तज्ञानेन ये, an incorrect variant in A and B.

(4) A reads अक्षोभ्या, which is incorrect.

(5) B reads देरदा.

पुष्पा पुष्पवती<sup>1</sup> पत्नी शालिनी रसिनी गुणा । .

एतत्तु च ~~एतत्तु~~<sup>2</sup> कार्यकासे प्रयोजयेत् ॥८३॥

अभ्रकं चैव व्योम<sup>3</sup> च गगनं ग्राहकं परम् ।

दुष्टवीर्यञ्च वातञ्च वज्रिनादोक्षताक्षति<sup>4</sup> ॥ ८४ ॥

अजरम् अमरं घोरं घोरवृद्धत्व<sup>5</sup> नाशनम् ।

रंसमूलरसातीतं रसज्ञे राज्यवर्धनम् ॥ ८५ ॥

अमृतम् अमरं<sup>6</sup> चैव महामृत्यावेना नम् ।

एतावन्-~~एतानि~~<sup>7</sup> ज्ञात्वा कर्माणि कारयेत् ॥८६॥

सोमलं मङ्गराजं च विषं वातविनाशनम् ।

क्षेतवीर्यं बलप्रप्तिं नोलउज्ज्वलकारकम् ॥ ८७ ॥

स्वेदनं भेदनं चैव ~~तत्तत्तत्तत्~~<sup>8</sup> ।

बन्धनं सर्वधातूनां मारणं पारदे रसे ॥ ८८ ॥

(1) A<sup>1</sup> reads पुष्पवती.

(2) एतत्तु च शिला नामान्, an incorrect variant in A and B.

(3) Generally used as व्योम.

(4) A reads वज्रिनादे एतः क्षतिः, which is incorrect.

(5) A and B read वृद्धत्व, which is incorrect.

(6) A repetition of the name.

गगनग्राहके दिव्ये रसमुग्धे प्रसन्नः ।  
 एतानि मन्त्रनामानि कार्याकाले प्रयोजयेत् ॥८८॥  
 हीनधातोश्च नामानि संक्षेपात् तानि च शृणु<sup>१</sup> ।  
 येन विज्ञानमात्रेण जायते पारदो जिज्ञा ॥ ८९ ॥  
 मुक्ता मुक्ताफलं वारि वारिजं स्वर्णसंजनम् ।  
 शुक्तिगर्भं<sup>२</sup> च सगरं शृङ्गारं म... ॥ ९० ॥  
 तैजसम्<sup>३</sup> अमृतोद्भूतं शीतलं शिलीमं मनः<sup>४</sup> ।  
 स्वयम्भुवं कलं दीप्तं स्त्रियि सौभाग्यदायकम्<sup>५</sup> ॥९१॥  
 रतिराजग्रहः शोभाकामसन्दीपनं तथा ।  
 मुक्तानामानि रम्याणि<sup>६</sup> ज्ञात्वा कार्याणि कारयेत् ॥९२॥

(1) A reads वने शृणु, which is incorrect.

(2) B reads शुक्तिगर्भं, which is not correct.

(3) B reads तैजसं, which is incorrect.

(4) B reads मनः, which is not correct.

(5) स्त्रियि सौभाग्यदायिजं, an incorrect variant in A and B.

(6) A and B read ते रम्यान्, which is incorrect.

विद्रुमं वरदं<sup>1</sup> वेलावल्लीजातं प्रवालकम् ।  
 नीरसम्<sup>2</sup> अधरेसौमा शिखरं शिखरोद्भवं ॥ ८४ ॥  
 वर्णदं विवरं चैव यैवेयं<sup>3</sup> च विभूषणम् ।  
 विद्रुमं रत्नमामानं<sup>4</sup> कार्थिकाले प्रयोजयेत् ॥ ८५ ॥  
 कूर्मकं कूर्मकं चैव कमठपृष्ठं सकालकम् ।  
 कमठं कर्कशं चैव कलिङ्गजातमाशुभम् ॥ ८६ ॥  
 कचकं कदम्बः<sup>5</sup> कर्मा लोके कचकटं तथा ।  
 एतानि कूर्मपृष्ठस्य नामानि च विशेषतः ॥ ८७ ॥  
 शङ्खं च जलजं चैव देववादिचमेव च ।  
 विष्णुवक्त्रभावं<sup>7</sup> चैव सोमदैवतकं शुभम् ॥ ८८ ॥

(1) A reads विद्रुमे वरदं. B reads विद्रुमे वरदे.

(2) A reads नीरसे.

(3) A and B read यैवेयं.

(4) A has विद्रुमैनामि. B has विद्रुमैनामि. Both are incorrect.

(5) कर्माशुभं is an incomplete variant in A and B.

(6) A has कचककदम्बः. B has कचककदम्बः.

(7) B reads erroneously विष्णुवक्त्रभावं.

वरायुधं च वरदं शुभ्रं ब्राह्मण्यदायकम् ।  
 अजेयं सर्वजन्तूनां दानवास्त्रि वरोदयम्<sup>1</sup> ॥ ८८ ॥  
 गम्भीरं घोषशब्दं च पवित्रं पारदं गृहम् ।  
 एतानि<sup>2</sup> शंखनामानि वामदक्षिणमाधुनी<sup>3</sup> ॥ १०० ॥  
 शुक्तिका सीफिका<sup>4</sup> कान्ती मुक्तामाता गरीयसी ।  
 चन्द्रपत्नी पयोपाही संपुटी पटवादिनी ॥ १०१ ॥  
 रजताभासिनी दीप्ता वःवारिविशोषणा ।  
 पद्माकरीगतिः पद्मगर्भ<sup>5</sup> समुद्रसन्धवा ॥ १०२ ॥  
 उत्तमा मध्यमा नीचा त्रिविधा सागरोद्भवा ।  
 नद्युद्भवा तु सा नीचा<sup>6</sup> नीचकर्माविशारदा ॥ १०३ ॥

(1) Both A and B read वरं द्यं, which destroys both grammar and metre.

(2) A and B read एतत्ते, which is grammatically incorrect.

(3) A reads वामदक्षिणमाधुनी. B reads वामदक्षिणमाधुनी.

(4) B has only सीफिका.

(5) A and B read पद्मेगर्भ.

(6) नद्युद्भवा तन्नीचा, an incomplete variant in A.  
 नद्युद्भवा तन्नीचा, an incorrect and incomplete variant in B.

एतत्तु लक्ष्यं युक्तैः<sup>१</sup> कर्मकाणि प्रयोजयेत्<sup>२</sup> ।

ब्राह्मण्यः कुरुते कर्म सिद्धयेत् सकलं फलम् ॥१०४॥

गजोन्नवं वरदं<sup>३</sup> दन्तं द्विजं चैव तु पुण्यकम् ।

नारीसौभाग्यदं चैव गजभूषणसम्पुष्टम् ॥ १०५ ॥

तैलरक्षाकरं श्रीदं संपुटं पुटिकं तथा ।

नामानि गजदन्तस्य चम्यानि मध्यमानि च<sup>४</sup> ॥१०६॥

पिच्छकं कुर्कुठं चैव शिखिपिच्छं सुविचकम् ।

हरिमौलिधरं श्रीदं मोहनं चन्द्रकं तथा ॥ १०७ ॥

नागारिं सूर्यदमनं विषदं विषनाशनम् ।

एतानि शिखिपिच्छस्य नामानि विविधानि च

॥ १०८ ॥

(1) A and B read एतत्तु लक्ष्यं युक्तैः, which is an incorrect variant.

(2) कर्मकाणि प्रयोजने, a variant in A, which seems to be incorrect.

(3) A reads वरदं, which is incorrect.

(4) चम्यानि मध्यमानि च, a variant in A and B, which is grammatically incorrect.

नखं सङ्गदयः<sup>१</sup> धातुकामलका<sup>२</sup> ।

वचं<sup>३</sup> दुर्गन्धिकं चैव तुरीटापसु चोभयम्<sup>४</sup> ॥१०८॥

काचं केशं च काशं च मूर्धजालकमेव च ।

श्यामं चैव घनं प्रोक्तं कर्कशं नर्णदं सप्त ॥ ११० ॥

एतानि धारणामाने यथाकर्माभिधानम् ।

ज्ञात्वा आरभ्यते कर्म स्वस्ते सिद्धिः प्रजायते ॥१११॥

पार्वत्युवाच ।

शब्धो शङ्कर विम्लेश विम्लनाथ जगद्गुरो ।

श्रुतानि चैव नामानि खानानि कथ्यन्तां<sup>५</sup> प्रभो ॥११२॥

(1) न हृदयपुरं, a variant in A. न हृदयपुरं, a variant in B. Both are incorrect.

(2) B reads कारकं.

(3) B reads वचं, which is not correct.

(4) A reads तुरीटापसुचोभयं.

(5) A and B read कथ्यन्तां, which is grammatically incorrect.

महादेव उवाच ।

शृणु देवि प्रयत्नेन स्नानानि विविधानि च ।

सुवर्णस्योदयो धातोः सर्व्वव्यापकपर्व्वते<sup>1</sup> ॥ ११३ ॥

पार्थिव्यं हि च तत् सर्व्वं<sup>2</sup> मृदामध्यात् प्रजायते ।

तस्मात् स्नानस्य संक्षेपः श्रूयतां सादरं<sup>3</sup> शुभे ॥ ११४ ॥

हेमं च प्रथमं कल्पं मेरुमध्ये सदैव हि ।

दुर्लभं मर्त्यलोकेषु कष्टेनैव तु लभ्यते ॥ ११५ ॥

पुनर्हमाद्रिणा तेन जायते सर्व्वदा शुभे ।

महाशीतकृते<sup>4</sup> तेन दुर्लभं स्यात् सदैव हि<sup>5</sup> ॥ ११६ ॥

पश्चाज्जम्बूनदोद्भूतं जम्बूद्वीपेषु जायते ।

तच्च कष्टतरं मन्ये दुर्लभं तत् सदैव हि ॥ ११७ ॥

(1) A reads वसौत. B reads पचांत. Both the readings are incorrect.

(2) पार्थिव्यानि च ते सर्व्वे, an incorrect variant in A and B.

(3) A and B read सादरात्, which is incorrect.

(4) A reads मङ्गलशीतकृते, which is incorrect.

(5) B reads सदैव हि, which is incorrect.

पृथिव्यां धातुमध्येषु सर्वेषामधिकं सदा ।

लोहाधिकतरं तत्र ज्ञातव्यं सर्व्वदा शुभे ॥ ११८ ॥

कष्टे निःसारणं तेषां मौल्यादधिकं जायते ।

तस्मात्तेनैव यत्नेन साधनं क्रियते नरैः<sup>१</sup> ॥ ११९ ॥

असाध्यसाधनं तस्य जातं सर्व्वयुगे शुभे ।

तस्मात्तु<sup>२</sup> बहुमूल्यान सर्व्वधातूपरिस्थितिः<sup>३</sup> ॥ १२० ॥

पुनः स्थानं कृतं तेन लङ्कायां च सदैव हि ।

उद्धृतं तेन यत्नेन मर्त्ताद्भीतं मया शुभे ॥ १२१ ॥

पार्व्वत्युवाच ।

महारुद्र शङ्कर श्रीमान्<sup>५</sup> लोकनाथ जगत्पते ।

कथं ते मानुषे भीतिः<sup>६</sup> कथ्यतां परमेश्वर ॥ १२२ ॥

(1) A has कृयते नराः. B has जयते नराः. Both are incorrect.

(2) A and B read तस्मात्त, which is incorrect.

(3) सर्व्वधातोपरिस्थितिः, an incorrect variant in A and B.

(4) A and B read erroneously मूल्याद्.

(5) श्रीमान्, a reading in A and B, is not correct.

(6) मानुषाद्भीतिः is the correct form.

महादेव उवाच ।

सुवर्णस्यैषा महती<sup>१</sup> भीतिर्मानुषसंभवा ।

उच्चो नीचघटं सम्भक् जायते बहुले रतिः ॥ १२३ ॥

मया मानुषभीतेन<sup>२</sup> उद्धितं सादरेण च ।

दुर्लभं च विशेषेण प्राक् कलियुगे वृद्धम्<sup>३</sup> ॥ १२४ ॥

पार्थ्व्युवाच ।

मदीये मानसे नाथ जातोऽसौ संग्रयो महान् ।

भवतां मानुषी भीतिः कथं तु जगदीश्वर<sup>४</sup> ॥ १२५ ॥

महादेव उवाच ।

कारणं वर्त्तते देवि प्रव्याख्येयं सदैव हि ।

कथनीयं त्वयि भद्रे यत्तत्त्वं<sup>५</sup> मम वल्लभा ॥ १२६ ॥

(1) A and B read सुवर्णस्यैषा महतान्, which is not correct.

(2) मां च मानुषीभीतेन, an incorrect variant in A and B.

(3) A and B read वृद्धे. This foot is incomplete.

(4) A reads कथं ते जगदीश्वरं. B reads कथं ते जगदीश्वरः.. Both are incorrect.

(5) यत्तत्त्वं is an incorrect variant in A and B.

दुःखे च १ तावच्चिर्जायते च कलौ युगे ।  
 मानुषे च भवतीह<sup>१</sup> मम चोभा-वर्त्तिनी ॥ १२७ ॥  
 तस्मात्तैर्बहुले<sup>२</sup> द्रव्ये साध्यते गन्धकी विद्या ।  
 अथवा पारदी चैव मम चोभानुवर्त्तिनी ॥ १२८ ॥

पार्वत्युवाच ।

श्रुता सा गन्धकी विद्या सर्व्वसौभाग्यदायिनी ।  
 सङ्गभक्षकता सा च<sup>३</sup> न सिध्यति गरीयसी ॥ १२९ ॥  
 भवता पूर्व्वमुक्तं हि सङ्गभक्षणयोगतः ।  
 न सिध्यति च ते विद्या सदा गन्धकपारदी ॥ १३० ॥  
 तस्मात्तु कथ्यतां देव मनोऽङ्गानिविवर्जित- ।  
 सुवर्णसाधिनीं विद्यां<sup>४</sup> तस्माद्वदतु मे विभो ॥ १३१ ॥

- (1) A and B read भवतीह, which is not correct.
- (2) A and B read तस्मात्, which is incorrect.
- (3) A and B read ते च.
- (4) A reads मत
- (5) A and B read सुवर्णसाधिनी विद्या.

महादेव उवाच ।

मानसं मदीयं देवि जातं सम्यक् सुनिर्मलम् ।

तथापि मानुषे भीतिर्विद्या<sup>1</sup> गन्धक्या<sup>2</sup> ॥१३२॥

सङ्गभक्षणजं कष्टम्<sup>3</sup> उभे मेलापनं महत् ।

सुष्ठु मन्त्रकृते वङ्गी ज्वलते तत्क्षणात् ततः ॥ १३३॥

मन्त्रवत् साधयेदविद्यां साधयेद्यज्ञतः क्रमात् ।

तस्मादेतैः महता गोप्या रिद्धिकरी क्रिया ॥१३४॥

पार्वत्युवाच ।

पुरा प्रोक्तं त्वया नाथ पटले पञ्चदशके<sup>3</sup> ।

कैलासात् परमं सौख्यं भजते मन्त्रविज्ञनः ॥ १३५॥

क्रिया गन्धकिनी<sup>4</sup> मध्ये अथवा पारदी शुभे ।

कैलासादधिकं सौख्यं भुञ्जते विधिवन्नराः<sup>5</sup> ॥१३६॥

(1) A and B read विद्मे, which is senseless.

(2) A and B have काष्ठ, which is incorrect.

(3) पटले पञ्चाधिके, a variant in A and B, which is incomplete.

(4) A and B read गन्धकिना.

(5) A and B read नरः, which is incorrect.

महादेव उवाच ।

निर्मलं मानसं जातं तव वाक्यविमोहितः ।

कथयामास ते भद्रे गुणलक्षणसंज्ञितम्<sup>१</sup> ॥ १३७ ॥

स्वर्णोत्पत्तिस्थलं<sup>२</sup> नित्यं सर्वत्रापि विधीयते ।

उत्पादनगतिस्तस्य स्थाने स्थाने पृथक् पृथक् ॥ १३८ ॥

श्रूयतां वरदे देवि स्थानं चैव यथोदितम् ।

तस्य वातोत्पत्तिं रेणुधूमने स्वर्णं<sup>३</sup> जायते ॥ १३९ ॥

पावकाद्रेर्भुवाबाहुः<sup>४</sup> सप्तरत्नाकरे तथा ।

समुद्रस्य तटे दिव्ये स्थानं स्यात् स्वर्णकस्य च ॥ १४० ॥

स्वल्पं च सिन्धुदेशेन कामरूपैस्तथैव च ।

अन्यैस्तु विविधैः स्थानैः साम्प्रतोत्पत्तिर्जायते ॥ १४१ ॥

(1) A and B read संयुतः, which is not accurate.

(2) Both A and B read स्वर्णोत्पत्तिः स्थलं, which is not correct.

(3) A and B add च after स्वर्णं.

(4) A reads पावकाद्रस्य शुभाबाहुः. B reads पावकाद्रस्य शुभाबाहुः.

तच्च तत्रोत्पत्तिस्तेषां यच्च यच्च हिमद्रवः ।

प्रसरन्ति भुवि संघाः<sup>1</sup> संशयो नास्ति ते सदा ॥ १४२ ॥

तान्त्रोत्पत्तिश्च मङ्गता सुखेनैव प्रकायते ।

तेषां ~~संघाः~~ वक्ष्येऽहं<sup>2</sup> याथातथ्येन च शृणु<sup>3</sup> ॥ १४३ ॥

नेपाले कामरूपे च<sup>4</sup> वङ्गले मदनेश्वरे<sup>5</sup> ।

गङ्गाहारे मलाद्री च ज्येष्ठदेशे तथैव च ॥ १४४ ॥

पावकाद्री जीर्णदुर्गे रुमदेशे फिरङ्गके ।

एतान्युत्तिस्थानानि<sup>6</sup> सर्वपर्वतके<sup>7</sup> सदा ॥ १४५ ॥

जासत्वं यत्तु<sup>8</sup> दिव्यं हि स्थानानि तस्य च शृणु ।

कुम्भाद्रावथ<sup>9</sup> कास्मीजे रुमदेशे बलचति ॥ १४६ ॥

(1) ~~संघाः~~ is the variant in A. ~~च~~ is the variant in B.

(2) ~~स्थानान् प्रवक्ष्यामि~~ is the incorrect variant in A and B.

(3) A ~~अस्ति~~ B read ते शृणु.

(4) नेपालं कामरूपं च, a reading in A and B.

(5) वङ्गालं मदनेश्वरं, a variant in A and B.

(6) एतानि उद्दिष्टस्थानानि, an incorrect variant in A.

(7) A and B read सपर्वतके, which is incorrect.

(8) A and B read यत्ते.

(9) A and B read कुम्भाद्रेय, which is incorrect.

एतान्भयोः स्नानानं<sup>१</sup> रजःस्नानं च<sup>२</sup> उच्यते ।  
 जासत्वं वङ्गले नार्ग नेपाले च सदैव हि ॥ १४७ ॥  
 केदारं कर्मकाण्डे च त्रयम्बके त्रिपुरे तथा ।  
 एतत् स्नानानं दिव्यानि<sup>३</sup> गोप्यान्यन्यानि  
 तानि ह<sup>४</sup> ॥ १४८ ॥  
 लोहाद्री<sup>५</sup> लोहसत्कर्म गयाद्री<sup>६</sup> गीतमाद्रि<sup>७</sup> के<sup>८</sup> ।  
 विश्वमध्य<sup>८</sup> हि सर्वत्र नलाद्री<sup>९</sup> निष्कलेऽपि वा  
 ॥ १४९ ॥

(1) एति उभयोः स्नानान्, a reading in A. एति उभयोः स्नानान्, a reading in B.

(2) A and B read रजस्नानानि.

(3) A and B read स्नानकान् दिव्यान्.

(4) चण्ण गोप्या तितेति ह, a variant in A and B, which is senseless.

(5) A and B read लोहाद्रे, which is incorrect.

(6) Do. Do. गयाद्रे, Do.

(7) Do. Do. गीतमाद्रिणे, Do.

(8) Do. Do. विश्वमध्य, Do.

(9) Do. Do. नलाद्रे, Do.

तम्रम्बके विमले<sup>1</sup> चैव लोहकाकशालिवाहने ।

समुद्रस्य तटे रम्ये आद्ये अन्ते च मध्यगे ॥ १५० ॥

लोहस्यैतानि स्थानानि<sup>2</sup> हाटकैश्च<sup>3</sup> सदैव हि ।

किञ्चित्<sup>4</sup> गोप्यानि दिव्यानि संस्कारैः रहितानि च<sup>5</sup>

॥ १५१ ॥

युक्ते तु संस्कृते तेषु स्वर्णी सिद्धिः प्रजायते ।

अयुक्ते नैव लभ्या तु<sup>6</sup> युक्ते प्राप्तिः सदैव हि ॥ १५२ ॥

पारदे गन्धके धात्वोः योग औषधकृत्<sup>7</sup> सदा ।

मानसे निर्मले चैव लभ्यते<sup>8</sup> हाटकी क्रिया ॥ १५३ ॥

(1) A reads विमले.

(2) लोहस्यैतानि च स्थानान्, a variant in A and B, which is incorrect.

(3) A reads हाटके च.

(4) किञ्चित् is the reading in A and B, which is incorrect.

(5) A reads ले. B reads ते.

(6) A and B read लभ्यते, which is not correct.

(7) Do. Do. यन्त्रौषधकृत्, Do.

(8) Do. Do. लभ्यते, Do.

अन्यथा नैव लभ्या तु<sup>१</sup> विना मन्त्रेण सिध्यति ।

तस्मादेवं<sup>२</sup> प्रयत्नेन निर्गलं मानसं शुभम् ॥ १५४ ॥

अशुभं समलं चैव मानसं सर्व्वदा भवेत् ।

तस्मात्तु चतुराहारे<sup>३</sup> सर्व्वदा शुभमानसः ॥ १५५ ॥

जायते च क्रिया सिद्धा हाटकी भवति सर्व्वदा ।

मन्त्रसिद्धिः प्रजायेत सर्व्वकार्याणि साधयेत् ॥ १५६ ॥

अनेनैव प्रकारेण उत्तमा हाटकी क्रिया ।

सर्व्वकार्य्यकरी नृणां चतुर्वर्गफलप्रदा ॥ १५७ ॥

महादेव उवाच ।

प्रोक्तसंपुटके चैव स्थूलकाचीयकेन च ।

उष्णाङ्गारकते अग्नौ<sup>४</sup> मुर्मुरं छागरेकजम् ॥ ८ ॥

- (1) A and B read लभ्यते, which is not correct.
- (2) A and B read तस्मादेवं, which is not correct.
- (3) A reads चतुराहारे, which is unintelligible.
- (4) A reads कृतेरग्नि. B reads चतेरग्नि.

खर्पराख्ये पुटे चैव चारुस्रोत्पलकेन च ।

सार्धं विनास्ति(?)गति च अवलिते चर्चमर्चगे<sup>1</sup> ॥ १० ॥

एवानुक्रमतो योगे पुटमिकां च जायते ।

चतुरंशेन आसत्वं सुवर्णादापयेत् सुधीः ॥ ११ ॥

प्रति संपुटपुटे चैव चर्चयेत् कुण्डलखर्परे ।

स्वाङ्गशीतं<sup>2</sup> समृद्धत्वं लेपमुत्तारयेत्ततः<sup>3</sup> ॥ १२ ॥

पुनर्लेपः प्रदातव्यः<sup>4</sup> पुनः चारान् प्रदापयेत् ।

पुनरेव घोटनं देयं सादरं पुनरेव हि ॥ १३ ॥

अग्निनैव प्रकारेण तुर्यांशसंपुटेन हि ।

सुवर्णसंयुतं तच्च<sup>5</sup> गालयेत् चारसंरतम् ॥ १४ ॥

अवलिते तोलयत्येव तिलाह्वं संपुटं प्रति ।

नस्त्रीभूतं च रक्षेयं संस्कारैः शुध्य साम्प्रतम् ॥ १५ ॥

(1) A and B read अवलितेरर्चमर्चगा.

(2) स्वाङ्गशीतेन is the reading in A and B, which is not accurate.

(3) A and B read लेपमुत्तारणं ततः, which is incorrect.

(4) A and B read पुनर्लेपं प्रदातव्यं, which is not correct.

(5) A and B read ते च, which is incorrect.

एतत्कमक्रमेणैव सुवर्ण<sup>1</sup>मनुसंख्य ।

तद्गुणे शोणमापीते महत्ततः प्रजायते ॥ १६ ॥

आरक्तं पीतसंयुक्तं जायते हाटकं महत् ।

हाटकं मत्तकं<sup>2</sup> चैव न च हीनेन योजयेत् ॥ १७ ॥

कलागुणगते वृद्धिर्जायते उत्तमे नरे<sup>3</sup> ।

अनेनैव प्रकारेण मात्राद्विगुणं दापयेत् ॥ १८ ॥

कलात्रय<sup>4</sup>मिते वृद्धिर्दापिता ॥ १९ ॥

निर्दोषं जायते दिव्यं द्रव्यसंपात्ते<sup>5</sup> ॥ २० ॥

पार्वत्युवाच ।

अधिकेन कृते तत्र<sup>5</sup> शोणपाने सुशोभने ।

जायते कीदृशं देव संयोगे अधिके सति ॥ २० ॥

(1) A and B read सुवर्णान्, which is not correct.

(2) A and B read हाटके मत्तके चैव.

(3) उत्तमो नरः, a variant in A and B.

(4) A and B have कलातर्क.

(5) A and B have ते च, which is incorrect.

महादेव उवाच ।

शोणपाने च संयोगे भङ्गदः अस्ति<sup>1</sup> निश्चयः ।  
 द्विगुण<sup>2</sup> शोणपानेन कलंकं जायतेऽशुभम्<sup>3</sup> ॥ २१ ॥  
 वेधसंगं सुधनार्थे त्रिंशं दिक्पलोपमम् ।  
 अतिरिक्तकृतं तच्च जायते सगुणं महत् ॥ २२ ॥  
 गालयेद्यत्रपूर्वेण छायेऽससमांशके ।  
 समांशे गन्धकं देयं शुद्धं पीतक<sup>4</sup> रागकम् ॥ २३ ॥  
 त्रयतुर्थांशकं तालं दापयेद्रसमोदितम् ।  
 तद्वर्द्धं सादरं देयं मर्हयेत् कन्यकारसे ॥ २४ ॥  
 यामत्रितयमामर्श<sup>5</sup> छायाः । अमण्डजे रसे ।  
 अतिशुष्केतरे खले अथवा लोहसंभवे ॥ २५ ॥

(1) A and B read भङ्गदा अस्ति, which is incorrect.

(2) Do. द्विगुणे.

(3) Do. शुभं, which appears to be incorrect.

(4) Do पीतक, which is senseless

(5) त्रयत्रयमामर्श, an incomplete variant in A and

मर्दयेद्यत्नपूर्व्वेण छायाशोषितं कारयेत् ।  
 काचकूप्ये प्रदातव्यं<sup>१</sup> वज्रिर्बालुकयन्त्रगः<sup>२</sup> ॥ २६ ॥  
 नखसंस्थामिते यामि पाचयेद्रसं शोभने ।  
 स्वाङ्गशोते तु संजाते पुनः खले निधापयेत् ॥ २७ ॥  
 रसेनानेन आमर्द्य छायाशोषितं कारयेत् ।  
 उक्तयामि रसे<sup>३</sup> दत्ते पुनः शोषं<sup>४</sup> प्रदापयेत् ॥ २८ ॥  
 उक्ताग्नौ दापयत्येव पुनः संस्कारमाचरेत् ।  
 संस्कारे त्रिविधे जाते अग्निपूर्व्वं क्रमोदिते ॥ २९ ॥  
 जायते रसराजोऽसौ सर्व्वसामर्थ्यदायकः ।  
 संचयेत्तण्डुलार्धेस्तु अतिविक्रमवेगवान् ॥ ३० ॥  
 जायते प्रबला बुद्धिः त्रिदिने सेवते यदि<sup>५</sup> ।  
 सार्धद्वद्विक्रमेणैव दिने मासफलं सदा ॥ ३१ ॥

(1) प्रदातव्या, a reading in A and B.

(2) यन्त्रगा, a reading in A and B.

(3) रसो is the variant in A and B.

(4) शोषं is the incorrect reading in A and B.

(5) A and B read सेवनेत्यपि, which is grammatically incorrect.

जायते नाच सम्येहः सिद्धिर्गन्धकसम्भवा ।

अनेनैव प्रकारेण रससिद्धिः प्रजायते ॥ ३२ ॥

\* \* \* \* \*

॥ अथ ॥ च ।

क्षेतता कर्मणा केन<sup>१</sup> जायते रजतेषु च ।

क्रमेण राजती सिद्धिः पञ्चाष्टाटकसम्भवा ॥ ३८ ॥

महादेव उवाच ।

अध्यानन्तरता विद्या धातुसंस्कारकारिणी ।

जासत्वे<sup>२</sup> कठिने जाते शुद्धे कोमलकारिणी ॥ ३९ ॥

तथाच पीतशुल्बेषु जायते शुद्धनम्रता ।

शृणु यत्ने क्रिया दिव्याः शुद्धजासत्वसम्भवाः ॥ ४० ॥

पिष्टं हयसुरोत्थं च द्विगुणं धातुतः सदा ।

अर्धन्तु दापर्येत् स्नावे अर्धं निम्ने च<sup>३</sup> रक्षयेत् ॥ ४१ ॥

(१) केन कर्मण, an incorrect variant in A and B.

(२) जासत्वं is the reading in A and B, which is not correct.

(३) A and B read निम्नेन.

निर्मलं धातुजं द्रावं स्वावचूर्णेन ठालयेत् ।  
यदर्धं च स्थितं निर्मलं तत्कालं दापयेत् सुधीः ॥ ४२ ॥  
उपरि संपुटं देयं समुद्रकुण्डे पुटे<sup>१</sup> ।

स्वाङ्गशीतं समुद्रतः जायते निर्मलं महत् ॥ ४३ ॥  
जासत्वे सोमलं देयम् उक्तभागेन<sup>२</sup> साम्प्रतम् ।

चूर्णान्तरगतं कृत्वा उज्ज्वलं जायते महत् ॥ ४४ ॥  
तदेव<sup>३</sup> जासत्वं चैव दिव्यम् उज्ज्वलगं सदा ।

रूप्यार्धं मेलयत्येव जायते शुद्धता शुभा ॥ ४५ ॥  
अग्नेनैव प्रकारेण धनं किञ्चिच्च जायते ।

धने चैव तु संजाते कारयेद्दूर्जजाः क्रियाः ॥ ४६ ॥

\* \* \* \* \*

अतीव शोभना विद्या रसगन्धकजा सदा ।

अतिसौभाग्यदा सा<sup>४</sup> च साधके सुखदायिका ॥ ४७ ॥

(1) समुद्रं कुण्डे पुटे, a variant in A and B, which seems to be incorrect.

(2) उक्तभागेन, a variant in A and B.

(3) A and B read स एव, which is not correct.

(4) Do.      ते,      Do.

एतादृशं च जासत्वं शोधितं गन्धकीनं च ।  
 घालधौतेन ताम्रेण पुञ्जितं<sup>१</sup> सुभगं सदा ॥ ६८ ॥  
 पुञ्जितं जायते दिव्यं शुल्बपीतं शुभोदितम् ।  
 निर्मलं जायते तच्च हीनहाटकसन्निभम् ॥ ६९ ॥  
 लघुता जायते तस्य किञ्चिन्नाय्या गुरुता सदा ।  
 जायते गुरुता दिव्या पुञ्जिते हाटकेन च ॥ ७० ॥

२८शः लादुधृताः श्लोकाः ।

पार्वत्युवाच ।

पूर्वमुक्तं त्वया नाथ धने सिद्धिस्तु जायते ।  
 लघुद्रवकृते धातौ<sup>२</sup> वद<sup>३</sup> किं तत्र मुह्यते ॥ ४३ ॥

महादेव उवाच ।

क्रिया अग्नेः शुभा तेषां द्रव्यसिद्धिविधायिनी ।  
 शृणु यत्नेन तां भद्रे क्रियां रंगीति नागजाम् ॥ ४४ ॥

(1) A and B read पुञ्जितं.

(2) A and B read धाते, which is incorrect.

(3) A reads वचः B reads वचः.

आनयेत् पारदं दिव्यम् अधजर्ह्विपातितम् ।  
 क्षालयेद्यत्रपूर्वेण स्वप्ने पिष्टं तु कारयेत् ॥ ४५ ॥  
 तैलेनानेन आमर्द्य भावना क्षणमात्रतः ।  
 निम्ने डमरुके यन्त्रे अग्निं दद्याद्विचक्षणः ॥ ४६ ॥  
 उत्थयेद्यामयुग्मेन स्वाङ्गशोतं समुद्धरेत् ।  
 पुनः समाननागेन पूर्ववत् क्षालयेत् सुधीः ॥ ४७ ॥  
 पुनरेव हठादग्नी उक्तयामेन मिह्यति ।  
 रसे द्विवारके चैव ह्रीनह्रीमोत्तमोत्तमः<sup>१</sup> ॥ ४८ ॥  
 तौलिके रक्तिकायुग्मं दापिते वर्णपञ्चकम्<sup>२</sup> ।  
 अनेनैव प्रकारेण जायन्ते षोडश कलाः ॥ ४९ ॥  
 द्रव्यवृद्धिकरं तच्च जायते नात्र संशयः ।  
 पुनरेव क्रिया रम्या पारदे नागचारिणी ॥ ५० ॥  
 द्विगुणे चारिते तत्र<sup>३</sup> जायते चन्द्रिका शुभा ।  
 आभासेन शिखिणीवा जायते नात्र संशयः ॥ ५१ ॥

(1) ह्रीनह्रीमोत्तमः. an incomplete variant in A.

(2) पञ्चकः is the reading in A and B, which is in correct.

(3) ते च is the incorrect reading in A and B.

पुञ्चिते हीनहेमेन जायते त्रयविक्रयः ।  
 अनेनैव प्रकारेण जायते धनसंपदः ॥ ५२ ॥  
 अतज्जुं क्रिया या च<sup>१</sup> विद्या नागस्य संभवा ।  
 रसे तु नागजे चैव विधिनामेन वर्त्तते ॥ ५३ ॥  
 तायते<sup>२</sup> सकला विद्या नागतैलस्य संभवा ।  
 सञ्ज्ञा सा<sup>३</sup> शोभना विद्या तीव्रदारिद्र्यनाशिनी ॥ ५४ ॥  
 अथातः संप्रवक्ष्यामि त्रयूणां विधिमुत्तमम्<sup>४</sup> ।  
 येन विज्ञानमात्रेण जायते रजतं महत् ॥ ५५ ॥  
 अनेका राजती सिद्धिः जायते परमोत्तमा ।  
 जायते धनसिद्धिश्च<sup>५</sup> जायते नात्र संशयः ॥ ५६ ॥

(1) A and B read ये च, which is incorrect.

(2) A and B have ताते, which is incomplete.

(3) A and B have ता, which is not correct.

(4) A and B have विधिरुत्तमा, which is grammatically incorrect.

(5) A and B have स्यात् instead of च, which is a tautology.

पार्ष्वत्युवाच ।

वद वैभवदातारं<sup>१</sup> वक्त्रं । वज्रानदायकः<sup>२</sup> ।

ज्ञात्वा सिद्धिमवाप्नोति गुणैः सौख्यकं च यम् ॥ ५७ ॥

महादेव उवाच ।

आनयेच्छोभनं वक्त्रं विख्यातलससुहृदम् ।

गालयेद्यत्रपूर्व्वेण ठालेत् त्रिभाण्डजे रसे ॥ ५८ ॥

त्रिःसप्तककृते तत्र<sup>३</sup> जायते निश्चलं शुभम् ।

तदुत्थान् कारयेत् पत्रान्<sup>४</sup> शुचिविद्वान् यथोदितान्

॥ ५९ ॥

रक्षयेद्यत्रपूर्व्वेण आनयेद्वर्किकं<sup>५</sup> पयः ।

भावयेत् शुक्तिकाचूर्णम् उज्ज्वलं वज्रिशोधितम् ॥ ६० ॥

(1) दाता च, a variant in A and B.

(2) दायकः, a variant in A and B.

(3) ते च is the incorrect variant in A and B.

(4) A and B read तदोत्थान्, which is incorrect. The word पत्र is used here in the masculine gender.

(5) B reads वज्रिकं.

मर्दयेद्यन्नपूर्व्येण यावन्नेपः सुलक्ष्यते<sup>1</sup> ।

यवाङ्गं लेपयत्येव पत्रान् तु यन्नपूर्व्वकम् ॥ ६१ ॥

कायाशुष्के च संजाते दापयेच्छुक्तिसंपुटे ।

चूडाधो लेपयत्येव सन्धी यन्नेन मुद्रयेत् ॥ ६२ ॥

मेलितौ माषगोधूमौ पिष्टलेपं प्रदापयेत् ।

कायाशुष्के च संजाते मृन्मयं लेपं दापयेत् ॥ ६३ ॥

मुशुष्के च<sup>2</sup> गजे पाच्यं स्वाङ्गशीतं<sup>3</sup> समुद्धरेत् ।

जायते उज्ज्वलं वङ्गं वातशुष्कं तु कारयेत् ॥ ६४ ॥

यः कश्चित् मूर्च्छितश्चैव<sup>4</sup> जीवयेज्जीवनक्रियाम् ।

स हि वङ्गाश्रयेणैव<sup>5</sup> उज्ज्वलः कठिनो<sup>6</sup> भवेत् ॥ ६५ ॥

(1) यावन्नेपस्य लक्ष्यते, a variant, which seems to be incorrect.

(2) मुशुष्केन, a variant in A and B.

(3) स्वाङ्गशीते, a variant in A and B.

(4) यः कश्चित् मूर्च्छिते ते च, an incorrect variant in A and B.

(5) मर्दयेद्यन्नपूर्व्वेण, a variant in A and B, which is unintelligible.

(6) A and B read उज्ज्वलं कठिणं, which is incorrect.

अतिशुद्धतरं तच्च जायते नात्र संशयः ।

सर्व्वकर्म्मकरं श्रेष्ठं नानाभागेन पुञ्चितम् ॥ ६६ ॥

भोगभागसमायुक्तं वङ्गं च गुणसंयुतम् ।

लक्षणार्थे<sup>१</sup> धनार्थे च<sup>२</sup> संयोगे साधयेत् सदा ॥ ६७ ॥

जायते सुभगं तच्च संसारं शोभनं भवेत् ।

अनेनैव प्रकारेण जायन्ते धनसम्पदः<sup>३</sup> ॥ ६८ ॥

पार्व्वत्युवाच ।

त्रयी शुद्धतरे जाते का क्रिया वद मे विभो ।

लक्षणार्थं धनसंपत्तेः क्रिया या च पृथक् पृथक् ॥ ६९ ॥

महादेव उवाच ।

लक्षणेन<sup>४</sup> च नारीणां भिक्षा भिक्षेन वर्त्तते ।

अनेका धनदा विद्या जायते सुभगा महत् ॥ ७० ॥

अतीव शोभना सा च रक्षसामर्थ्यदायिका ।

येन विज्ञानमात्रेण साधके धनं त्तमम् ॥ ७१ ॥

(1) B reads भक्षणार्थे.

(2) धनार्थे is omitted in B.

(3) जायते धनसंपदा, a variant in A and B.

(4) A and B read भक्षणेन.

जायते नैव सन्देहो धनसामर्थ्यकं महत् ।

अतिसौम<sup>१</sup> तिजायते नात्र संशयः ॥ ७२ ॥

आमयेत् शुद्धं तं वङ्गं गालयेत् टङ्गणैः सह ।

पिण्याकसुरसे दिव्ये ढालयेद्यन्नपूर्वकम् ॥ ७३ ॥

सप्तढालकते शुद्धे कठिनं रजतोपमम् ।

जायते नैव सन्देहः पुञ्जिते रजते शुभे ॥ ७४ ॥

रजतं जायते शुद्धं संभारं कारयेत् सुधीः ।

अन्येष्वेव विधिर्दिव्यो दिव्यरजतसंभवः<sup>१</sup> ॥ ७५ ॥

आमयेत् शोधितं वङ्गं तदर्धे पारदे छलेत् ।

निधाय<sup>२</sup> शोभने खले तुर्यांशे दापयेत्ततः ॥ ७६ ॥

मर्हयेत् दण्डाली<sup>३</sup> यामं षोडश यन्नतः ।

हंसपद्या रसे दिव्ये तत्समं मर्हयेत् सुधीः ॥ ७७ ॥

समानाण्डरसेनैव मर्हयेद्यन्नपूर्वकम्<sup>३</sup> ।

कायाशुष्के च<sup>४</sup> संजाते शोषान्ते<sup>५</sup> बालुके पचेत् ॥ ७८ ॥

(1) . दिव्यादिव्यं रजतसंभवा, a variant in A and B.

(2) A and B read निधाय or निधाय.

(3) यन्नपूर्वकः, a variant in A and B.

(4) कायाशुष्केन, a variant in A and B.

(5) A reads शीघ्रान्ते. B reads सोम्यान्ते.

अग्नेनैव प्रकारेण क्रमेण प्रदापयेत् ।

प्रहराष्टकेऽष्टकेनैव त्रिवारं षष्ठं दापयेत् ॥ ७८ ॥

जायते च रसं दिव्यं भक्षणे च सुधास्रमम् ।

नारीणां दापयेद्यत्ने संयोगे नागकेसरैः<sup>1</sup> ॥ ८० ॥

तदर्क्षाः सुष्ठु<sup>2</sup> गोधूमाः सहैवं ते लकादिम् ।

अतिसौख्यकरं तच्च<sup>3</sup> रक्तिमाचार्यं वर्धते ॥ ८१ ॥

पुंसि अजगुणोपेते यथा च गंधकी गतिः ।

नरार्थे भक्षणे यातो जातित्रयसमन्वितः ॥ ८२ ॥

अग्नेनैव प्रकारेण क्रमेण वर्धयेद्भ्रसम् ।

जायते रसजा सिद्धिः नात्र कार्या विचारणा ॥ ८३ ॥

सुकृत् सुधाकरं वज्रं गालयेद्यत्नपूर्वकम् ।

तज्जलं शोषयत्येव शतांशे रसदापिते ॥ ८४ ॥

रजतं जायते शुद्धं कलाद्वाचिंशतः स्फुटम् ।

अन्यं वै मेलयत्येव विक्रमे शुभदं महत् ॥ ८५ ॥

(1) A reads नागकेसरै.

(2) B reads चिदु.

(3) A and B read ते च, which is incorrect.

अनेनैव प्रकारेण जायते धनसंपदः ।

साधयेत् सिद्धिदा विद्या देहसामर्थ्यदायिनी ॥ ८६ ॥

मेलयेद्भोगभागेन मर्हनाहरदो विधिः ।

पीते भावनया अग्नी<sup>१</sup> सार्धवृष्टेन सिद्धयेत् ॥ ८७ ॥

शुद्धताम्रे प्रदातव्यं शतांशे हाटकोत्तमम् ।

जायते नात्र सन्देहो यथा जाम्बूनदोद्भवम् ॥ ८८ ॥

\* \* \* \* \*

पार्वत्युवाच ।

ताम्रं च तुल्यजं दिव्यं जायते केन विक्रियाम् ।

वद विश्वेश्वर शश्वो सिद्धिं ताम्रविधानकीम्<sup>२</sup> ॥ ८९ ॥

महादेव उवाच ।

शृणु शुद्धक्रियां दिव्यां तुल्यताम्रस्य सन्भवाम् ।

येन विज्ञानमात्रेण साधयेद्द्रव्यताम्रकाम् ॥ ९० ॥

साधयेत् पञ्चामृतं दिव्यं महासौख्यप्रदायकम् ।

ज्ञात्वा कालेन लीयेत संसारसुखभाजने ॥ ९१ ॥

(1) A and B read रक्षौ, which is incorrect.

(2) सिद्धा ताम्रविधानकं, an incorrect variant in A and B.

आनयेत्तुत्यक्तं दिव्यं पीतगन्धकसम्भवम् ।  
 दापयेच्छोभने स्तब्धे चर्कचूरेण भावयेत् ॥ ६७ ॥  
 मर्दयेद्यत्रपूर्वेषु यामभावमिति तम् ।  
 तेनैव धातुयोगेन सुवर्णं<sup>२</sup> सुलभतां व्रजेत् ॥ ६८ ॥  
 एतादृशी परा धातुर्वर्त्तते धातुर्मध्यमा ।  
 सुलभा शुभदा प्रोक्ता मम सान्निध्यगा सदा ॥ ६९ ॥

पार्ष्वत्युवाच ।

ये गुणा नागजे तान्मे वद विद्वस्व वज्रभ ।  
 प्रयोजनवस्तु शक्यं चतुरेष्वेव चोदितम् ॥ ८५ ॥  
 महादेव उवाच ।  
 अनेका गुणा<sup>३</sup> नागेषु पूर्वमुक्ता हि<sup>४</sup> पारदे ।  
 किञ्चित् शेषतरा ये च शृणु देवि प्रयत्नतः ॥ ८६ ॥

(1) A reads यामभावमखण्डितः. B reads यामभावे मखण्डितः.

(2) A and B read सुवर्णः.

(3) अनेकान् गुणान्, a variant in A and B.

(4) सुक्तानि पारदे, an incorrect variant in A and B.

नागस्य सन्धर्वं ताम्रं मध्ये मेलापनं कृतम् ।  
 विभागे तु कृते तत्र जायते कुम्भिका शुभा ॥ ८७ ॥  
 तन्मध्ये गालयेन्नामं चिदारं यत्रपूर्वकम् ।  
 जायते निष्कलं स्वर्णम् उदितं चैव कुम्भिके ॥ ८८ ॥  
 विभागे साम्प्रतं दत्त्वा अमृतं जायते शुभम् ।  
 उक्तका ॥ ८८ ॥ इति नान्यथा वचनं मम ॥ ८९ ॥  
 तस्मात् साधयते दिव्यं भूनागोद्भवजं शुभम् ।  
 अनेका साधयेद्विद्या रससामर्थ्यदायिका ॥ ९० ॥

Colophon in A

इति श्रीरुद्रयामले उमामहेश्वरसंवादे सुवर्णकल्पे  
 सुवर्णप्रशंसा नामाध्यायः ।

Colophon in B

इति श्रीरुद्रयामले उमामहेश्वरसंवादे धातुमंजर्यां  
 सुवर्णप्रशंसा समाप्ता ।

(1) A and B read ते च, which is incorrect.

Extracts from  
**SUARNATANTRA**  
OF  
**SVARNATANTRA.**

सुवर्णतन्त्रात् वा स्वर्णतन्त्रात्

उद्धृताः श्लोकाः ।

A = MS. from Benares. •

B = MS. from Ramnákálí's matha, Dacca. †

श्रीगणेशाय नमः ।

श्रीराम उवाच ।

देवदेव महादेव ऋद्धिबुद्धिफलप्रद ।

पूर्वं संस्मृचिता ऋद्धौ रसायनपरा परा ॥ १ ॥

यस्याः साधनमात्रेण स्वारादृतुष्यो गरो भवेत् ।

तां सिद्धिं वद मे देव यदि त्वं भक्तवत्सलः ॥ २ ॥

• The name of this MS. is सुवर्णतन्त्रम्.

† The name of this MS. is स्वर्णतन्त्रम्.



पूर्वं तु कथितं देव रत्नतन्त्रं त्वया मम ।  
 गुटिकाः कथिताः पूर्वं सहस्रद्वितयं शिव ॥ ३ ॥  
 पारदाः कथिताः पूर्वं षट्शतं मृतिरूपकाः ।  
 धातूनामष्ट कल्पास्तु पूर्वमेव प्रकाशिताः ॥ ४ ॥  
 धातुयोगास्त्यकल्पस्तु पूर्वमेव प्रकाशिताः ।  
 रत्नानां करणे तन्त्रं पूर्वमेव प्रकाशितम् ॥ ५ ॥  
 किन्तु स्वर्णास्त्यतन्त्रं तु न मन्त्रं कथितं प्रभो ।  
 कश्यपेन महेशानाभ्यर्दितोऽस्मि महेश्वर ॥ ६ ॥  
 भूमिदानं मया दत्तम् ऋषये कश्यपाय वै ।  
 कश्यपेन मयि प्रोक्तं भूमिभागं त्वज प्रभो ॥ ७ ॥  
 स्थानार्थं तु महेशान रक्ताब्धिः प्रार्थितो मया ।  
 वाणमात्रं स्थलं तेन दत्तं मम महेश्वर ॥ ८ ॥  
 स्थानं प्राप्तं महेशान भक्षणं मम नास्ति वै ।  
 भक्षणं देहि मे देव यदि पुत्रोऽस्मि शङ्कर ॥ ९ ॥

शङ्कर उवाच ।

नृणु राम प्रवक्ष्यामि रत्नतन्त्रं त्वयै स्वकम् ।  
 स्वर्णतन्त्राभिधानं तन्त्रं कल्परूपेण कथ्यते ॥ १० ॥

तत्राद्यं स्वर्णतन्त्रस्य कस्य मृष्टं सुपुत्रक ।

तैलकन्दाभिधः कन्दः सिद्धकन्दः प्रकीर्तितः ॥ ११ ॥

कन्दः कमलवत्तस्य पञ्चाणि कञ्जवन्निष्ठो ।

तथैव तु महत्पत्रं तैलं स्रवति सर्वदा ॥ १२ ॥

जलमध्ये सदा पुत्र त्वार्द्र एव प्रतिष्ठते ।

विषकन्देति विख्यातो विषाच्च कायनाशनः ॥ १३ ॥

तैलस्त्रावी महाकन्दः परितस्तैलवज्जलम् ।

तस्मात्तस्मात् देशे सरते तैलवज्जनम् ॥ १४ ॥

महाविषधरः पुत्र तदधो वसति ध्रुवम् ।

कन्दाधः कन्दच्छायायां नान्यत्र गच्छति प्रिय ॥ १५ ॥

तत्परीक्षाविधानार्थं कन्दे सूचीं प्रवेशयेत् ।

सूचीद्रावः क्षणात् पुत्र तत्कन्दन्तु समाहरेत् ॥ १६ ॥

तत्कन्दं तु समादाय शुद्धसूतं खलेन्निधा ।

मूषायां निक्षिपेत् तन्तु तत्तैलं तत्र निक्षिपेत् ॥ १७ ॥

दीप्ताग्निं तु महाराम वंशाङ्गारेण दापयेत् ।

तत्कन्दाग्निमृतिमायाते लक्षवेधी भवेत् सुत ॥ १८ ॥

ततः प्रभक्षयेद्ग्राम क्षुब्धिद्राहारको ध्रुवम् ।

तालं शुद्धं समानीय तत्तैलेन खलेत् सुत ॥ १९ ॥

सप्तधा प्रत्यहं राम त्वेवं विंशद्दिनं भुवम् ।  
 हरितालो वृत्तिमेति निर्धूमो जायते भुवम् ॥ २० ॥  
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 तत्तालं चाष्टधाती तु दद्याद्वावे कृते सति ॥ २१ ॥  
 सर्ववेधी भवेदेव शतविधो भवेत् सुत ।  
 तत्तैलं तु समादाय ताम्रद्रावे विनिक्षिपेत् ॥ २२ ॥  
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 वङ्गे कांस्थे यदा दद्यात्तदा रौप्यं भवेत् सुत ॥ २३ ॥  
 ताम्रे लौहे तथा रौप्यां तारे स्वर्परसूतके ।  
 तत्क्षणात् वेधमायाति दिव्यं भवति काञ्चनम् ॥ २४ ॥\*

\* \* \* \* \*

शंखद्रावस्य भेदान् हि तत्कल्पान् ऋषिः साम्प्रतम् ।  
 लौहद्रावस्तथा ताम्रद्रावश्चैव द्वितीयकः ॥ १ ॥  
 शंखद्रावस्तृतीयः स्यात् इन्तालस(?) चतुर्थकः ।  
 दन्तद्रावः पञ्चमः स्यात् अन्कवेधी तु मध्यमः ॥ २ ॥

पद्यानां तु परीक्षा वै कथ्यते नृक्ष साम्प्रतम् ।  
 लौहसूचीं समादाय लौहद्रावे विनिक्षिपेत् ॥ ३ ॥  
 तत्क्षणाद्भवतां याति सा सूची नात्र संशयः<sup>१</sup> ।  
 ताम्रद्रावे तथा सूचीं सन्निभेदीं विनिक्षिपेत् ॥ ४ ॥  
 सूचीद्रावो याममात्राद्भवत्येव न संशयः ।  
 शंखद्रावे शंखसूची चतुर्यामेन संद्रवेत् ॥ ५ ॥  
 हस्तालोऽधो<sup>२</sup> यदा गच्छेत् दन्ताद्यान्ता भवन्ति हि ।  
 दन्तद्रावोऽप्यधो गच्छेत्~~दन्ताद्यान्ता~~ बो भविष्यति ॥ ६ ॥  
 एवं परीक्षां कृत्वादी प्रयोगानारभेद्भुवम् ।  
 वज्रमूषां ततः कृत्वा शुद्धसूतं विनिक्षिपेत् ॥ ७ ॥  
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 तत्राग्निं दापयेद्यत्नात् पुनस्तत्र<sup>३</sup> रसं क्षिपेत् ॥ ८ ॥

(1) The above 7 hemistichs are not found in A.

(2) A reads दन्ताद्याधो. B reads दन्ताद्याधो. Both the readings seem to be incorrect ; since B has हस्तालस्य चतुर्यकः in the 2nd Sloka.

(3) B reads पुनस्तस्य, which is not correct.

स सूतो - ततामेते<sup>1</sup> नात्र कार्या विचारणा ।  
 अष्टधातुषु तं सूतं दत्त्वा काञ्चनतां व्रजेत् ॥ ९ ॥  
 तं सूतं भक्षयेद्यो हि सोऽमरत्वमवाप्नुयात्<sup>2</sup> ।  
 तस्य मूत्रपुरीषेषु शुक्लं<sup>3</sup> भवति काञ्चनम् ॥ १० ॥  
 ताम्रद्रावप्रयोगं वै शृणु यत्नेन साम्प्रतम् ।  
 तद्रसं तु समादाय शुद्धताम्रे विनिक्षिपेत्<sup>4</sup> ॥ ११ ॥  
 तत्ताम्रं स्वर्णतां याति भैरवस्य प्रसादतः ॥ १२ ॥

Colophon in A—इति श्रीसुवर्णतन्त्रे हरपार्वतीसंवादे  
 दुस्यर्षाकल्पः द्वितीयः ।

Colophon in B-- इति स्वर्णतन्त्रे लोहद्रावादिपञ्च-  
 फलकल्पो द्वितीयः ।

- (1) B has सा सचौ मृत्तिमाप्नोति.
- (2) A reads स गच्छेदमरत्वतां, which is incorrect.
- (3) B reads शुक्लं.
- (4) शुद्धताम्रेषु निक्षिपेत्, a variant in B.

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